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ABSTRACT

The Center on Education and Training for Employment at the Ohio State University worked in partnership with the Ohio State Building and Construction Trades Council to develop and deliver customized workplace literacy services for local union members in six major Ohio cities (Columbus, Cleveland, Cincinnati, Toledo, Dayton, and Akron). A third-party evaluator was hired to determine the extent to which the project goals and objectives had been accomplished. A modified version of the Context-Input-Process-Product model was used to evaluate the program through interviews of program participants and staff, observations of instructional sessions and staff meetings, and a review of project materials. It was concluded that the project provided approximately 360 participants' with the job-specific basic skills required to be able to participate successfully in union-sponsored technical skills enhancement training courses. Recommendations included more rigorous and comprehensive preservice instructor training and allocation of more staff time to communication and monitoring or all project activities. (Appendixes constituting approximately 75% of this document contain the following: pre- and postassessment data analysis, participant data, copies of interim reports to the project director, sample literacy task analyses, and sample curricula.) (MN)

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Center on Education and Training for Employment
of The Ohio State University's College of Education
and
Ohio State Building and Construction Trades Council

WORKPLACE LITERACY DEMONSTRATION PROJECT:

Building Essential Skills for the Ohio Building and Construction Industry

External Evaluation
FINAL REPORT

Prepared by
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U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
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July, 1995

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Introduction

Background:

The Center on Education and Training for Employment (CETE) of The Ohio State University's College of Education, in partnership with the Ohio State Building and Construction Trades Council (OSB&CT) , was funded by an 18-month grant award from the U.S. Department of Education and in-kind local resources to provide workplace literacy services for local union members, (*e.g.*, journeymen carpenters, electricians, and sheet metal workers), in Columbus, Cleveland, Cincinnati, Toledo, Dayton, and Akron. The program, housed in local union training facilities and jointly staffed by special project-hire instructors and union trainers, was funded as a national workplace literacy demonstration project from March 1, 1993 to August 31, 1994, with an 8-month no-cost extension through April 30, 1995, to determine the effectiveness of the CETE/OSB&CT proposed workplace applications of basic skills training model.

The need for this project grew from a recognition by local craft unions throughout Ohio, the CETE, and the OSB &CT that contractors are less and less willing to hire construction workers who cannot use advanced technologies. In Ohio, there are 193 local unions in 14 different crafts affiliated with the OSB &CT Council. These unions represent approximately 53,800 member union workers who need to maintain and upgrade their skill levels in order to continue practicing their crafts during a period of rapid technological change and the accompanying pressures of increased job complexity and competition. Over ninety-eight percent of the construction employers who hire union members are small businesses with 50 or fewer workers. Significant changes in the construction process focus on materials used on jobs and in training programs. Because of such occupation-wide upgrades in construction processes, even many workers with long experience do not have the up-to-date skills and certifications necessary to obtain or keep long-term employment in their crafts. The situation is especially critical for workers who completed apprenticeships 15-20 years ago; they frequently experience extended

unemployment periods and, when referred for work through the union system, often are not hired or retained due to lack of skills. These journeymen require technical training to continue employment and increase their ability to perform job tasks without errors. Yet low basic skills often preclude admission to or mastery of available training programs for many of them. In order to provide a well-trained workforce that will keep Ohio economically healthy, the partners perceived a need for something more than just technical training courses for construction craft workers.

Because technical training-specific courses and traditional education often do not give workers a broad-based knowledge of team communication, problem solving, critical thinking and learning how-to-learn concepts and competencies, the partners determined the need for instructional programs that would provide Ohio construction union members with workplace basic skills applications that are transferable and adaptable to their changing work environments. In a recent survey of the 193 local member unions in Ohio conducted by the OSB &CT Training Foundation, Inc. and the Center for Labor Research at The Ohio State University, business managers and training directors reported that an average of approximately 30 percent of the workers in each union were below the level of functional literacy for their particular craft. The responses ranged from a low of 5% to a high of 100% where the training directors determined that all of their workers needed additional basic skills in literacy and numeracy. Due to the suspected large union member population of low-level applied basic skills, the partners began to formulate plans for a solution to the problem.

Prior to the funding cycle, the CETE had begun discussions with the OSB& CT and local union representatives to foster the sharing of information and to clearly define local worker needs and agency responses. This careful exploration of possibilities resulted in their partnering to apply for federal grant monies for provision of on-site basic skills programs to accompany local union training courses. Administrators representing OSB &CT and local unions met with the CETE program developers to ensure that the

customized programs directly related to the competencies needed for union training courses and would respond to the needs of the targeted local union member participants. To this end, the education/labor partnership members were committed to gathering data for performing a "front-end analysis" in order to assess the basic skills needs of targeted trainee-participants. They also determined program goals, scope of trade-related content areas, instructional unit length, schedules, recruitment and implementation plans. This cooperative relationship continued throughout the funding cycle.

The developers of the program, CETE staff and project special hires that comprised a professional staff of 6 instructors and university-based program advisors and developers with numerous advanced degrees and many years of experience in writing and teaching, then custom-designed, created, and delivered the instructional program. Complete participant assessment procedures and an integrated functional-technical basic skills training program were subsequently implemented during the grant period. The Ohio State University Research Foundation, as the grant fiscal manager and on behalf of the CETE, contracted with Performance Plus Learning Consultants, Inc., to serve as a third-party evaluator throughout the project.

Purpose of the Evaluation:

The Center on Education and Training for Employment of The Ohio State University's College of Education and Ohio State Building and Construction Trades Council has requested this third-party evaluation of their U.S. Department of Education Workplace Literacy Demonstration Project to assess: 1.), the extent to which the project's goals and objectives have been accomplished; and 2.), the extent to which program development, implementation, expansion, and institutionalization proceeded as planned. Specifically, the evaluation objectives to be investigated were:

- on-going identification of the program's strengths and areas needing improvement throughout the life of the project;

- evidence that approximately 360 participating workers' job-specific basic skills have been increased to the levels needed for [union-sponsored] technical skills enhancement training courses through

  - provision of adult literacy and other adult basic skills services and activities to upgrade or update the basic skills of adult workers in accordance with changes in workplace requirements, technology, products, or processes, as documented in DACUM Enhance Literacy Task Analysis (DELTA) conducted with union workers and their employers;
  - development of assessment and evaluation activities, *i.e.*, qualitative and quantitative tools to measure basic skills growth and subsequent placement outcomes;
  - provision of instruction for improvement of the competency of adult workers in speaking, listening, reasoning, and problem solving; and,
  - provision of educational counseling, transportation, and child care services for adult workers during non-working hours while the workers participate in the project.

- evidence of a smooth flow of instructional activities within the curricula, reflecting a collaborative model of instruction, in which workers themselves participate, and sound developmental approach to mastery of those literacy skills necessary for competent performance of identified job or job training tasks;

- evidence of increased participating workers' enrollment and completion of skill enhancement courses through

- development and use of record-keeping and documentation systems, including collection, interpretation, and reporting of data on program development and implementation of activities and on individual progress of participants; and,
- development and use of appropriate processes for participant recruitment and selection, class scheduling, development of individual education plans, curriculum delivery, pre-and post-test assessment, and instructor training and support, that are academically and organizationally sound and that match with program goals.

- evidence of an improved job placement record of participating workers in comparison to that of a control group, as documented for both participants and a matched group of non-participants in each city; and,

- evidence of program information dissemination at all levels, including the national level, through the assistance of the AFL-CIO Education Department and conference presentations, such as those of the American Society of Training and Development, the American Vocational Association, and the Commission on Adult Basic Education.

Description of the Project to be Evaluated:

The Building Essentials for the Ohio Building and Construction Industry Workplace Literacy Project consisted of a workplace literacy training partnership formed between the Center on Education and Training for Employment of The Ohio State University's College of Education (CETE) and Ohio State Building and Construction Trades Council (OSB &CT), with assistance from local construction unions around the state. According to the published description of the program, the design of the project was structured to meet workers' and trainees' job-specific basic skills application needs in union craftsmen, employed by local construction contractors, through the development of

functionally contextual curricula. On-site investigations and job analyses conducted by project staff resulted in the development of some customized curricula and instructional delivery formats tailored to meet the various needs of local unions in the areas of carpentry, electrical work, and sheet metal work. A brief description of the program follows:

> On-site, job-linked and general math and reading instruction, along with instructional units on teamwork, speaking, listening, writing, study skills, and learning how-to-learn concepts, was offered as small group and whole group sessions at local union training facilities in six Ohio cities. Each course was scheduled for a 12-week period and accommodated a maximum of 25 participants per class. Six special project hire instructors were provided with training in workplace literacy techniques and functional context theory by CETE staff, then began working directly with local union trainers to review technical training materials and develop lesson plans for team-teaching delivery. Participants were assessed at the beginning of each course and asked to self-evaluate their learning styles and learning needs. This information was then incorporated into the development of a series of specific lesson topics to address participant needs, and lessons were delivered using techniques to accommodate participant learning styles. Sessions were scheduled to meet on Saturday mornings for 4.5 hours each, for twelve weeks, for a total of nine courses. At some locations, participants opted to meet on week nights instead. Courses were offered during late fall and early winter months in order to coordinate class schedules with off-peak construction work seasons. Overall, 127 union workers participated, with sets of paired pre- and post-assessment data available for 82 participants, for a total of 3079 contact hours. Gains of 4.35% and 1.20% were documented with the *ABLE* Number Operations and Problem Solving test components, and gains of less than 1/400 and 4/390 on the ETS *Test of Applied Literacy Skills* Document and Prose tests. Post-

course self-report by participants indicated that they believed learning had occurred. Average attendance was 38.97 hours, or 72%.

Individual lessons were developed on a variety of applied basic skills and "soft skills" that facilitate workplace communication, supervision, and teamwork. Because the worker participants at each union training facility site self-selected those topics in which they perceived personal needs for instruction, the content of each course was unique to the class for which it was developed. Materials varied greatly in quality and sources. Most instructional sessions were comprised of instructor explanations and demonstrations to the whole group, followed by participant use, independently or in small groups, of handouts excerpted from commercially published basic skills/technical texts and workbooks. A small amount of customized, teacher-created instruction contained word problems as work-specific examples for participants to use as vehicles for learning job-linked literacy skills used by construction workers and trainees. No instructor scripts were developed, allowing freedom in delivery and interpretation based on the professional discretion of each individual instructor or instructor/union trainer team. Each instructor incorporated personal learning materials and activities into the delivery of one or more lessons, as deemed appropriate for specific participants.

Method

Design:

The evaluation of Building Essential Skills for the Ohio Building and Construction Industry Workplace Literacy Demonstration Project employed a modified version of the Context-Input-Process-Product (CIPP) model, (Stufflebeam & Guba, 1971). This method of evaluation was chosen by the evaluator as the most suitable tool for investigating the evaluation objectives, (see pages 6-7), because it examines project effectiveness through structured analysis of the cohesiveness of project goals, components, and operations, independent of comparisons to outside standards or other programs.

The CIPP model was used to analyze:

- Context (*i.e.*, shared goals and philosophy of key personnel and participants);
- Input (*i.e.*, resources, including personnel, materials, time, and facilities);
- Process (*i.e.*, congruence of observed instructional development and delivery with project goals and research on instructional effectiveness); and,
- Product (*i.e.*, indicators of project effectiveness).

It is important to note that, due to geographical considerations, much of the on-going site investigation was conducted by project special hire staff and reported to the

project internal evaluator at CETE, who then reported to the evaluator. Information was also reported to the evaluator during two site visits or via telephone, electronic mail, or written communication by the internal evaluator and the Project Director. Forms and procedures for use in data collection across sites were recommended and reviewed by PPLC, and developed in part by PPLC and in part by project staff.

Participants:

The participants in the project were union members in carpentry, electrical work, or sheet metal work, sponsored by their locals. A brief description of the available composite average participant profile is provided below for reference:

Composite Average Participant Profile

White male, 35 years of age, with a high school diploma, having trade school or military service training, currently employed, having worked in the trade or belonged to the union for 10.5 years.

More detailed demographic information about participants is displayed in Figure 1 on the next page.

Instruments:

Data for this evaluation were requested and gathered via structured interviews with participants, union local trainers, and project special hire instructors; formally documented on-site observations of instructional sessions; observations and reports of instructor training; and observation or taped recordings of initial, mid-project, and final project personnel meetings at CETE. Additionally, data were gathered from detailed analysis by the evaluator of program documentation, available instructional materials, and participants' work (*i.e.*, participants' records and pre- and post-test scores).

Figure 1: Demographic Characteristics of Participants		**(n = 127)**
Category	**Totals**	**Percentage of n**
Average Age in Years	34.72	(N/A)
Ethnicity:		
White	113	88.98%
Black	10	7.87%
Hispanic	3	2.36%
Asian	1	0.79%
Gender:		
Male	123	96.85%
Female	4	3.15%
Single Head of Household	62	48.82%
Limited English Proficiency	17	13.39%
High School Graduate	106	83.46%
GED	6	4.72%
College Degree	6	4.72%
Have Taken Some College Courses	45	35.43%
Hold Job Certification(s)	44	34.65%
Trade School or Military Experience	79	62.20%
Currently Employed	98	77.17%
Average Number of Years Worked in Trade/Union	10.57	

Procedure:

Following initial telephone and in-person conversations with the Project Director to establish evaluation objectives, the evaluator conducted the activities listed below. Five site visits were made during the funding period.

1. Development and Review of Data Collection Instruments:
   - CETE internal evaluation data collection plan reviewed; PPLC forms reviewed and modified for Instructor Interview, Participant Individual or Focus Group Interview, Classroom Observation, and Union Trainer Interview.

2. On-site consultation with Project Director; OSB&CT representative; craft union representatives; project Specialists for Literacy, Adult Education, and Mathematics; project special hire instructors; and internal evaluator, concerning teacher training, recruitment, curriculum development and delivery, pre-and post-assessment, data collection, and institutionalization issues. (Dates of visits to CETE, Columbus, OH: *August 5, 1993; March 4, 1994; and, June 28, 1994.*)

3. On-site interviews with union trainers, project special hire instructors, and participants. (Dates of visits: *Cleveland, OH, March 4-5, 1994; Toledo, OH, March 18-19, 1994; Dayton/Cincinnati, OH, February 7, 1995; and, Cleveland, OH, February 8-9, 1995.*)

4. On-site observations of learning activities during various cycles of instruction: (Dates of visits: *Cleveland, OH, March 4-5, 1994; Toledo, OH, March 18-19, 1994; Dayton/Cincinnati, OH, February 7, 1995; and, Cleveland, OH, February 8-9, 1995.*

5. On-site attendance at initial and mid-project meetings at CETE, Columbus, OH. (Dates of meetings: *August 5, 1993* and *June 28, 1994.*)

6. Off-site analysis of materials, data collected from sites, and recording of final project meeting (held at CETE, Columbus, OH, March 13, 1995.)

7. Communication and Operations:
   - Contact throughout grant period with project through conversations and electronic mail communiqués with Project Director, Sandra Pritz,

to discuss project goals, progress, evaluation activities and preliminary findings.

- Interim Reports submitted to Project Director:
  - April, 1994
  - July, 1994
  - February, 1995
- Final Report submitted to Project Director, July 1995.

Results

Project Context:

To what extent are goals and philosophy of the project shared by key project personnel and participants?

This section of the evaluation is a comparison of the project goals and priorities as reported in project descriptions and interviews with key project personnel, including:

- project director
- OSB & CT representative
- regional union local representatives
- project specialists
- project special hire instructors
- local union trainers
- participants.

These viewpoints about project goals were analyzed for consensus and divergence.

The published project goals and purposes are contained in the grant proposal submitted to the U.S. Department of Education. They were developed cooperatively following communication between the CETE, OSB & CT, and union local leadership for each city, prior to applying for the grant monies. Stated goals in the proposal were:

- to increase participating workers' job-specific basic skills to the levels required for technical skills enhancement training courses;

- to increase participating workers' enrollment in and completion of skill enhancement courses; and,
- to improve the job placement record of participating workers in comparison to that of a control group.

Project Director: Sandra Pritz, Project Director, representing CETE, was interviewed early in the project about her perceptions of program goals and philosophy. She articulated the project goals as stated in the proposal and indicated that project activities were underway to support them. Activities included the results of the DACUM DELTA process that had been conducted for Sheet Metal, Electrical, and Carpentry tasks to be shared with special hire instructors to ensure that the content of courses was 100% job-specific, and review of commercial work-related basic skills materials under consideration to make available as resources during implementation of instruction. A learning style inventory and several additional self-assessment instruments had been selected for use, as well as customized Cloze tests and commercially developed assessment tests (ABLE, TALS), to assist local union member/participants in determining what topics they wished to include in the courses, during the first session offered at each of the local sites. The Project Director noted that equally important to the goals stated in the proposal were the goals of: 1.), furthering the workplace literacy instructor training process through high levels of CETE staff involvement with project special hire teachers and union trainers as they developed from "green" to experienced workforce literacy curriculum developers and instructors; and, 2.), investigating the ways to put into practice what is already known about cognitive science and human development through the development of functionally contextual instruction for workplace literacy classes.

OSB & CT Representatives and Regional Union Local Representatives: C.J. Slanicka, OSU professor of labor and training and direct consultant/liaison with the OSB & CT; David Williams, Vice President of the OSB & CT and representative for the Toledo Sheet Metal Workers locals; and, Patrick Day, OSB & CT director of field operations, met with

the evaluator on August 5, 1993. They unanimously stated the main program goal to be educating people represented in the crafts and bringing them up to the levels of new technology now required in the trades, by upgrading literacy skills requisite for acquiring those technical skills. They cited the reluctance of many union members to participate in technical skills training that was offered and speculated that many had basic skills levels of 8th-12th grade, with many older members not even having high school level math skills. Two of the three expressed opinions that the courses offered during the project should be 100% work-related basic skills; the third member of the group felt that it was sometimes necessary to begin with everyday life skills, then gradually lead into related work skills for each topic covered. All emphasized the importance of allowing the participants freedom to choose the topics to include within a course, based on individual perceived needs, that the key to retention and recruitment would be the enthusiasm expressed by initial participants. Additionally, two of the group members mentioned that the team teaching structure for delivery would serve the purpose of enhancing the skills of the union trainers at each facility as they worked with the project special hire instructors to develop, schedule and deliver topics in the courses. They hoped that the project would, in this way, enable the union locals to build capacity for program replication after the funding period.

Project Specialists: Johanna DeStefano, Susan Emil, and Tina Lankard, for literacy, adult education, math, and evaluation at CETE were interviewed during site visits in August, 1993; March, 1994; and June, 1994. Each specialist stated goals that concurred with those published in the proposal and mentioned activities underway that supported them. Materials had been gathered and presented to the project special hire instructors on the theory and techniques of functionally contextual instruction for workplace literacy programs. Adult education instructional techniques had been reviewed with them, as well, and sources of additional information made available to them. The original math specialist targeted for the project was unavailable. Evaluation goals were mentioned as those stated in the proposal, to determine whether or not published

objectives were being met. No specific activities had yet been undertaken at the time of the interviews. Specifically mentioned by the specialists were the following goals:

- to determine how the selection and training of traditional teachers and union trainers to develop and deliver functionally contextual workplace literacy materials can lead to successful workplace literacy programs;
- to determine how to create conditions during instruction that promote self-directed inquiry among participants; and,
- to demonstrate that the proposed participatory model of curriculum development and delivery is superior to other instructional processes.

Project Special Hire Instructors and Local Union Trainers: were interviewed at instructional sites in Cleveland, Cincinnati/Dayton, and Toledo. All project special hire instructors stated that the goal of the program was to create and deliver 100% work-related instruction in basic skills, and all noted that, in actuality, their lessons were approximately 50% work-related basic skills and 50% traditional academic skills. Union trainers all felt that the courses should be 100% job-related in content. One project special hire instructor noted that a major goal of the program was the facilitation of "learner-developed" materials by the instructors, *i.e.*, that the participants would bring in work or home problems which the instructor would then help them solve, using basic skills.

Participants: were interviewed during focus groups conducted at six locations: Cleveland carpentry local training facility, Cleveland sheet metal local training facility, Toledo sheet metal local training facility, Toledo electrical local training facility, Cincinnati/Dayton carpentry/millwright local training facility, and Cleveland electrical local facility. Responses to the questions, "Why are you taking this course? What do you hope to get out of it?" and "What are the most important things you should be learning from this program?" included the following:

- to drastically improve my math, reading, English and speaking skills to prepare for new work requirements;

- to improve my communication skills;
- the more you learn, the more you can earn; to make more money.
- to learn about myself and how I learn, how I process data taken in;
- to better understand others and myself, how to interact with other people;
- to become aware of my body language with others;
- to obtain more money and benefits;
- to better myself and have a higher standard of living;
- to reawaken my brain (I've been out of school for a long time);
- to receive a math brush-up;
- to learn what's behind what I do in the field;
- to have my apprentices understand what I tell them to do;
- to improve myself with a minimum of effort;
- to broaden my horizons;
- to have an advantage over those who don't take this class (it'll look good on my resume);
- to stay employed;
- to have more offers of employment (skills are worth higher pay, maybe an increase of $10 an hour for me);
- to develop leadership qualities; and,
- to figure out job materials and learn how to solve the job problems that drive us crazy.

PPLC collected and analyzed goal statements from the project director, OSB & CT representative, regional union local representatives, project specialists at CETE, project special hire instructors, local union trainers, and participants. For a discussion of areas of convergence and divergence, please see the evaluation section, "Summary of Results," under Discussion. PPLC next investigated the input of resources to the project, which addressed in the next section of the evaluation.

Project Input:

What resources were available to the project during development and implementation and to what extent were they used effectively?

This section of the evaluation addresses major resources of the project. It includes program instructional materials, design and appropriateness for targeted learner populations; key personnel qualifications and time commitments and the extent of their matches with published project duties; and facilities. It also examines the content and processes used for instructor training. The data presented in this section were analyzed for strengths and weaknesses.

Program materials: The instructional materials were designed and/or purchased for use with the *Building Essential Skills for the Ohio Building and Construction Industry* at the local union training facilities after project special hire instructors were given a day of training in the theory and techniques for designing functionally contextual workplace literacy curricula. Documentation of the DACUM Enhanced Literacy Task Analyses (DELTAs) that had been conducted by CETE prior to this training had not been verified at the time of the instructor training. The evaluator was unable to determine whether or not the instructors were furnished with copies of these documents to use as a resource in designing curriculum for the program. Based on discussions with instructors, trainers, the project director, and the project specialists, the choice of skills for instructional content at each site was that identified by participants as necessary to support performance of job tasks and procedures. This was accomplished through self-assessment inventories and standardized testing. In this way, each site developed its own "participatory learning program" with local participants.

Review of the curricula in use at each instructional site visited during the funding period demonstrated a wide variety of materials in use. At only two locations was there

any evidence of integrated technical and applied basic skills instruction jointly delivered by the project special hire instructor and the union trainer. Materials at one of these sites (Cleveland sheet metal) had been specifically designed for use with the course and consisted of chalkboard diagrams and participant handouts that utilized technical knowledge, job-specific basic skills applications and scenarios or problems drawn directly from job situations, focusing on math and use of formulas. At the other site (Cleveland electrical), the union trainer and project special hire teacher jointly demonstrated techniques for communicating with co-workers and utilized hand outs and hands-on experiments with actual job tasks as instructional vehicles for job-specific applied basic communication skills. At two of the other sites (Cleveland carpentry and Toledo electrical), the participants moved from a class with the project special hire instructor in traditional basic skills to a class with the union trainer in technical skills. Little or no coordination of topics was discernible by the evaluator. Duplicated pages from commercially available academic basic skills texts were utilized as hand outs during the classes conducted by the project special hire instructors. At the sites (Cincinnati/Dayton carpentry/millwrights and Toledo sheet metal), project special hire instructors worked alone, without assistance from a union trainer. As in the previously described two sites, duplicated pages from commercially available academic basic skills texts were utilized as handouts. At one of these sites, the project special hire instructor presented duplicated handouts and transparencies from a college psychology publication on the topic of passive aggressive behaviors, conducted exercises on neurological impressioning, and had participants role play animal characteristics as they interpreted them from photographs. None of the instructors gave reference to those commercial texts from which they had excerpted and duplicated materials for use within the courses.

The evaluator requested that each project special hire instructor submit completed lesson plans, objectives, and materials for each session upon completion of the course, but only a handful of sample duplicated materials was able to be obtained from them and forwarded by CETE staff. Of those various instructional materials received and those

collected during site visits by the evaluator, the ranges of reading difficulty level and skill complexity appeared to match the ability levels of targeted participants for facility of use. Diagnosis of ability levels of targeted course participants was obtained from reported scores on the ABLE, TALS, and Cloze tests administered during the initial class session. This was intended to ensure a match between program participant ability levels and planned instruction. Results of the tests indicated the following average scores:

Adult Basic Learning Exam (ABLE), Levels 2 & 3:	
-Number Operations.....	average score = 71.55%
-Problem Solving.....	average score = 78.97%
-Vocabulary.....	average score = 92.69%
-Reading.....	average score = 92.27%
Educational Testing Service *Test of Applied Literacy Skills* (TALS):	
-Document Test.....	average score = 333
-Prose Test.....	average score = 346
CETE-developed *Cloze Tests*:	
-Level I (6th grade).....	58%
-Level II (8th grade).....	60%

A *Learning Styles Inventory* from the Murdock Teacher Staff Development Center of Witchita Public Schools (Witchita, KS) ,on which participants marked on a polarized 4-point scale if each of a series of 45 items was "most like me" or "least like me," was utilized to identify learning styles. Participants then scored and graphed their responses to identify and rank individual learning style preferences as "major," "minor," or "negligible."

Based on results of these inventories, instructors were to modify instructional styles to meet the needs of participants in each group. Average scores are given below for each learning style, represented as fractions of the total possible score for each style:

Visual language	28/36
Visual numerical	30/34
Auditory language	28/36
Auditory numerical	30/30
Auditory Visual Kinesthetic Combination	33/34
Individual Learner	29/32
Group Learner	28/32
Oral Expressive	26/30
Written Expressive	22/34

The results show an almost even distribution of learning styles, with the most preferred styles being auditory numerical (learning best by hearing numbers and brief explanations) and auditory-visual-kinesthetic combination (learning best through combined stimuli that includes opportunity to manipulate actual materials). The least preferred styles were visual language (learning best by reading about something using text), auditory language (learning best by hearing about something), and written expressive (better organization of thoughts when writing than when speaking). Review and observation of materials used demonstrated little, if any change from traditional adult basic education classroom delivery techniques of whole group lecture, small group and individual activities, utilizing exercises that required participants to record answers on worksheets.

Participants were also asked to complete a self-assessment to identify those topics they most desired to have included in the course content. Participants were asked to mark topics on a pre-determined list. Results, expressed as fractions of number of participant

responses/ total number of participants indicated that participants felt they needed to learn the following:

Communicating	32/107
Teamwork	9/107
Math	36/107
Reading	25/107
Writing	33/107
Spelling	31/107
Solving Problems	25/107
Listening	11/107
Speaking	25/107
Job Skills	16/107
Study Skills	34/107

Math, study skills, writing, spelling, and communication were identified most frequently as those topics desired by participants. Based on this information, it appears that at those locations from which instructional materials were made available to the evaluator for review, participants' selections of topics were being addressed in instruction. When asked about the strengths and weaknesses of instructional materials, the majority of participants thought the content reinforced the skills they needed.

No instructor scripted guidelines for individual course sessions or overall use and integration of materials were developed; instead, instructors were left to use professional judgment for matching materials with participant needs, based on assessment instrument scores and any information they could obtain from the union trainers about technical skill requirements. Instructors seemed to tend to repeatedly use their personal "favorite" excerpts from commercial texts. Variations in instructor communication styles, topic interests, and personalities appeared to impact on quality of instructional delivery, as well.

(See Appendix C: Interim Reports Submitted to Project Director for more detail on program materials.)

Key Personnel: Project special hire instructors were seasoned teachers with expertise and years of experience in adult basic education, corrections, higher education, vocational education, and business/industry training. Instructor qualifications required included experience in adult or secondary education with a workplace or vocational setting and a degree in education at either a bachelor's or master's level. Most of the instructors commented on the positive aspects of learning new techniques and of having learned about the trades from their participants. When asked to estimate the amount of time spent in preparation for teaching per course and to list estimated percentages of instructional time applied to specific tasks per course, instructors reported the following:

Preparation time (in weeks)	% Time Instruction	% Time Preparation	% Time Materials Development	% Time Clerical/Misc.
8	32%	27%	11%	30%
6	48.5%	33.5%	14%	4%
6	585	16%	2%	24%
8	31%	31%	18%	20%
-	56%	37%	1%	6%
-	57%	32%	9%	2%
-	30%	26%	12%	32%
-	32%	37%	05	31%
-	90%	5%	0%	5%

The estimates submitted indicate that the majority of time spent by each project special hire was in preparation and delivery of instruction, with considerably less time spent in

developing functionally contextual job-specific applied basic skills instructional materials, contrary to what was anticipated by CETE and published in the proposal.

The Project Director, Sandra Pritz, holds a Masters degree in Economics and has extensive experience in managing workplace literacy projects for CETE. Ms. Pritz's credentials include a lengthy list of educational research studies and investigative work in the area of adult learning and program administration. The time commitment for the Project Director was listed as 50%. Although evidence was unavailable to document actual hours, levels of project activity and observation during site visits would indicate that the specified number of hours were spent on project activities. These included conducting the DELTA job literacy analyses for each of the three selected crafts, convening project meetings, overseeing day-to-day operations, and overseeing the development/adaptation/ selection of curriculum materials as dictated by the DELTA data. The Project Specialists for literacy (Dr. DeStefano), adult education(Dr. Imel), and internal evaluation Ms. Lankard) also appeared to spend the specified allocations of work time on project tasks, this being a range of 15%-28% of total time. Their project duties included training of instructors, monitoring practices during project operation, monitoring instructors work, identifying and accessing instructional materials, ensuring the use of appropriate assessment instruments, gathering craft-specific literacy audit data, establishing and monitoring the data collection process, and implementing dissemination plans.

Facilities: Instruction was conducted on site at local union training facilities for each city for one or more of the three crafts selected, *i.e.*, sheet metal work, electrical work, or carpentry. All facilities visited by the evaluator were modern, state-of-the-art buildings that appeared well-lit and conveniently located, with spacious accommodations for conducting learning activities and counseling.

Instructor Training: Initial training was provided for the project special hire instructors at CETE by the project specialists. A large packet of print materials related to

the theoretical underpinnings and techniques for development of functionally contextual workplace literacy instructional materials was bound in book form and given to each instructor. Additionally, information was distributed and discussed concerning the assessment instruments and their use. Information was also presented about record keeping and data collection for the project, accompanied by forms to be used. A day-long training was held at the beginning of the project, but many of the original instructors were replaced during the period of the grant, due to personal circumstances that necessitated their leaving the project. A second, 2-hour training was provided for project special hire instructors by the CETE project specialists during the mid-project meeting in June, 1994.

For a discussion of strengths and weaknesses of available project resources and the effectiveness of their use, see "Summary of Results" under the Discussion section of the evaluation. The next section of this evaluation examines the process of project operations.

Project Process:

To what extent were program development and observed instruction congruent with project goals and research on instructional effectiveness?

Instructional Organization: The DACUM Enhanced Literacy Task Analyses was conducted on the three craft areas of carpentry, sheet metal, and electrical work. For each craft, this process involved bringing together 8-12 workers in that craft, who, working under the guidance of a trained CETE facilitator, brainstormed the duties and tasks for their job. After building group consensus for each identified duty and task, the group prioritized and/or sequenced these tasks. The group spent several days reviewing and refining their work and extended their analysis to brainstorming those literacy skills needed to perform each task (*i.e.*, reading, writing, speaking, listening, and computation). No actual observation of job performance occurred. The outcome was three profile charts, giving detailed portrayal of job duties and tasks, as reported by the representative worker group members. Verification of the resulting profile charts was requested from six union locals for each craft. Responses were received from 3 electrical locals and 3 sheet metal worker locals. No carpentry locals responded. It is unknown whether the results of the DELTAs were shared with the project local hires or not. (See "Appendix D: Sample Literacy Task Analyses" for additional details on the DELTA results.)

A total of one hundred seven local union members were assessed and self-reported on learning styles and needs during the first sessions conducted for each course at the various locations. Instructors then used the results to diagnose participant needs and develop/adapt/select content materials at appropriate levels of placement and topics. In most instances, project special hire instructors selected and adapted from commercially published materials and did little creation of original materials.

Instructional sessions held during the project were of 4-4.5 hours duration for a 12-week period, and met one time per week, usually on a Saturday morning from 8:00 a.m. to 12:30 p.m. The courses were conducted in Columbus, Cleveland, Cincinnati/Dayton, Toledo, and Akron/Canton. Individual participant files and cumulative records were unavailable for review at any of the sites visited, but data sent to CETE and forwarded to the evaluator included test scores, information from intake forms, and self-assessment results.

The nature of instruction and types of learning activities were determined through observation, as well as interviews with both instructors and participants. Both participants and instructors reported that approximately 50% of instructional time was spent working in whole groups, 25%-35% working in small groups, and 25%-35% working independently. Records from instructional session observations by the evaluator indicated an average of 5%-10% of instructional time was spent in one-on-one instruction with participants. This compares satisfactorily with an ideal of less than 50% teacher-talk during any one instructional session (Goodlad). On-site interviews and observations occurred six times during various phases of the project.

Instructor Engaged Time: Participant engaged time during observations was relatively high. Most participants appeared to want to learn, seemed to enjoy moving through the instructional units, and spent 75%-85% of time in class actually working on group activities or paper-pencil exercises. The program participant engaged time and interaction with instructors compares favorably with engaged times of 40% -50% reported for observations of high school classrooms (Mikulecky). Adult participants came ready to work and managed twice as much effort per hour as adolescents manage in school rooms.

Instructional Quality: The quality of instruction provided by the materials has been discussed earlier in the Input section of this evaluation. It was, for the most part, traditional in nature. Four of the six project special hire instructors observed had

established good rapport with participants and took an active role in monitoring participant progress, encouraging participants, and providing explanations and examples when necessary. The other instructors appeared uncertain of their role in a work environment with few mandated guidelines for topic and materials to be used. They remained seated at desks in the front of the classroom training areas and mainly used a lecture style delivery of instruction.

Solid judgments of the quality of instructor explanations of concepts were observed at most locations. A lack of consistency in instructor ability to explain the thought processes for the job-related basic skills application procedures was evident. Not all instructors were able to explain several approaches to mathematics in a manner that took into account special cutting dimension considerations or that elicited the thought processes involved. Several instructors observed fell back to simply repeating procedures from instructional materials or stating step-by-step processes for memorization. This contrasts with the stated goal of instruction and the CETE project staff's intent that customized materials be created that represented embodiment of cognitive sciences, were functionally contextual and job-specific for each craft, and developed to meet the specifically stated needs of the participants to assist them in mastering their technical craft skill courses. This also contrasts with current state-of-the-art transfer of learning practices for workplace literacy in both the military and private sectors that result in highly effective application of instruction with training that refocuses instructional delivery practices for the teaching of memorized academic procedures to the teaching of comprehension via modeling the thought processes (metacognition) used in applying skills to performance contexts.

For discussion of project process, please see "Summary of Results" under Discussion section of the evaluation. Following receipt of final data in July, 1995, PPLC assessed program outcomes (or "product") to determine the degree of project effectiveness.

Project Product:

To what extent are there indicators of project effectiveness?

The C.I.P.P. model enables gathering of evaluation data from more than one source to promote triangulation of results in an attempt to arrive at valid conclusions concerning project effectiveness. PPLC evaluated the *Building Essential Skills for the Ohio Construction and Building Industry* program from three different perspectives of the users:

- participant pre-assessment/post-assessment scores;
- participant self-evaluations of skills learned and of personal learning goal statements; and,
- interviews and taped conversations with CETE project staff, OSB & CT representatives, project special hire instructors, union trainers, and regional union local representatives.

Participants' Instructional Gains: Participant scores on pre- and post-program assessment instruments were compared by average percentiles or average scaled scores. Minimal gains were obtained in all categories. The average median and mode (most frequent) scores on the pre-assessments were as follows:

Pretests	Scores		
	Average	Median	Mode
ABLE Number Operations	71.55%	77.00%	99.00%
ABLE Problem Solving	78.97%	90.00%	99.00%
ABLE Vocabulary	92.69%	96.50%	99.00%
ABLE Reading	92.27%	93.00%	92.00%
TALS Document	333.11	340.00	350.00
TALS Prose	346.77	350.00	370.00
Cloze Level 1	57.89%	61.00%	65.00%
Cloze Level 2	60.29%	60.50%	70.00%

Post-assessment scores were as follows:

Posttests	Scores		
	Average	Median	Mode
ABLE Number Operations	76.88%	82.00%	98.00%
ABLE Problem Solving	80.43%	87.00%	99.00%
TALS Document	334.10	330.00	350.00
TALS Prose	351.77	360.00	370.00

Average gains by percentage were as follows:

Pretests/Posttests	Average Gains (%)
ABLE Number Operations	4.35%
ABLE Problem Solving	1.20%
TALS Document	0.73
TALS Prose	3.78

A complete display of scores by individual participant, assessment task, and category of assessment by task can be seen in "Appendix A: Pre- and Post-Assessment Data Analysis.

Meeting Participants' Goals: The second aspect of project effectiveness was collected from participants themselves on CETE post-program comment sheets, and by structured interviews conducted by the evaluator on site visits, to determine the degree to which participants in the program were able to achieve their personal learning goals. During interviews, most participants expressed satisfaction with the content of the courses. Frequently mentioned was the building of confidence that enabled participants to use the skills they were learning in order to improve current job task performance (*i.e.*, communication skills with others), or to prepare themselves for better job opportunities. In asking participants to rate the program the evaluator heard that the contents, instructors, and schedules all received ratings of "extremely helpful" or "very helpful." Participants' reasons included liking the individual attention they got because of encouragement and that their questions were answered; instructors who seemed to really understand participants' needs and were able to explain things well; convenience of meeting times and locations; and the relevance of materials to their personal needs. Suggestions for improvements were few; those that were mentioned included a desire for

computer training and more courses like these early in the apprenticeship programs offered by the local unions.

Participants completed post-program forms for CETE and responded to an item that asked them what they felt they had learned. Responses (n = 82) were as follows:

Skills Learned: Self-Report	Total of Responses (per category listed on form)
Writing	7
Spelling	6
Expressing an Opinion	13
Problem Solving	30
Reading to Remember	11
Reading for Details	15
Reading for Analyzing Information	16
Analyzing information on Charts	13
Working with basic math	16
Working with fractions	30
Working with decimals	25
Working with percents	23
Understanding how I learn best	12
Study Skills	10
Pay Attention to Detail	1
Speed in Math	9
Recording and Retrieving	5
Computation	11
Geometry	7
Determining Outcomes	7
Reading Comprehension	5

Unsolicited remarks on the CETE forms included the following comments:

- The instructors were excellent!
- I never used to be comfortable with my learning abilities as I am now. I've wanted to go to college for a long time and now I will.
- I did not realize how important it is to improve my reading and math skills. I guess at my age (45), I thought it was too late to improve.

- I do feel that I've learned many valuable skills which can be useful to my personal and professional life.

- The main thing that has helped me is being able to read materials better. The class brought out things on communications that will give me knowledge of what is needed for getting a point across.

- The course has given me new outlooks in interpersonal skills. Example: I try to step back and evaluate the situation before judging. I try harder to listen to all. I look at my job from more perspectives, such as the employers' point of view. I also feel more confident in my abilities.

- The greatest thing about this course was the flexible format. Our instructor, having evaluated our initial test results, was able to determine our strengths and gave us a choice of what we wanted to learn.

- The "Competitive Edge" class increased my feeling of self-worth and value to society.

- The class has helped me in the workplace and I feel it is important for it to continue. I have become more aware of people who are not like me.

- The teacher was excellent in making sure everyone understood what we just finished before moving on.

- I was given a job I had never done before. If it hadn't been for the blueprint reading activity we did in class last week, I wouldn't have known where to start. With that in mind, I went to the prints first and had no trouble doing the job.

During structured interview sessions at sites, the evaluator asked participants to respond to the following question: *What grade would you give this course? Why?* At all

locations visited, participants said they would assign a letter grade of either A or B+ to the course. Reasons mentioned were that they felt they were "actually learning some things that they used to take for granted, but now better understood as adults," that they could "talk to the instructors and ask questions" (unlike memories of school), and that they were "allowed to express opinions."

Interviews with CETE, OSB & CT, Project Staff, and Local Union Representatives: During meetings held at CETE in Columbus, Ohio, on June 28, 1994 (mid-project) and on March 13, 1995, which the evaluator attended or had tape recorded, key project personnel assembled to discuss perceived project progress, outcomes, and issues. Discussions focused on the topics of recruitment and retention, assessment, instructional strategies, and future plans. Lessons learned included the following:

Recruitment and Retention:

- importance of scheduling and advertising with enough lead time to notify potential attendees.

- better results when attendance is mandated by union.

- although the program was originally intended for journeymen who had lots of experience but who had recently joined the unions and were working without the benefit of apprenticeship training courses, the program seemed better suited and more needed by final-year apprentices than by experienced journeymen.

- notifying participants' employers of their enrollment in the program helped obtain encouragement from employers to maintain attendance during all sessions; letters a good way to communicate this to employers.

- the name of the program is important; don't use the word *literacy*.

- offer seasonally during off-peak work periods for construction; need to coordinate offerings carefully with training program technical courses.

- problems recruiting union members who are perceived as needing this type of training most (*i.e.*, older workers and those with very low basic skills levels).

Assessment:

- this aspect of program important for grant, but would "play down" in any future programs.

- some instructors didn't use assessment, just "asked guys what they wanted."

- offer participants breakdown sheets of items and scores so they can identify their own areas needing improvement.

- some instructors used the Myers-Briggs instead of the assessment instruments; felt participants didn't need basic skills, but rather should have instruction in managerial skills.

- some instructors did no post-testing because pretest scores were high.

- important to assess so that group needs can be identified and met.

- how assessment is introduced to the group of participants is critical; needs to be seen in positive light.

- probably important to assess apprentices as they come into the union training program.

- reactions to assessment ranged from little resistance by some groups of participants to outrage by others.

Instructional Strategies and Materials:

- participants selected individual and small group exercises as their preference.

- older workers enjoyed small groups best.

- most effective techniques seemed to be role-play and small group exercises.

- instructors learned from each other (union trainers and project special hire instructors).

- project special hire instructors learned about trades from the participants.

- when time slots were alternated between the basic skills classes and the technical training classes, with one supporting the content of the other, the participants reported doing better in the technical skills classes.

- instructors with counseling backgrounds can do much to change the attitude of participants, especially in those courses that were mandated at some sites.

Future Plans:

- would like to make this type of training part of the regular technical union training courses.

- would like to continue this type of training, but budgets are uncertain.

- would like to continue this type of training in the future, but would want to see it in the apprenticeship program, rather than as elective training for journeymen.

- could offer continuing education units for credit at OSU to participants.

- would like to have OSU or OSB & CT "find" additional funding to replicate the program after the funding period is over.

Additional project products included evidence of dissemination through printed materials and articles published by CETE. These included an issue of their *Project Profile* publication describing the project and the preparation of an instructor handbook that is currently underway. No other information concerning conference presentations, articles, or publicity through AFL-CIO as listed in the proposal was made available to the evaluator.

For a discussion of project product, or outcomes, please see "Summary of Results" under the Discussion section of the evaluation report, which begins on the next page.

Discussion

Limitations of this Study:

There was one factor that acted as a limitation on the ability of this study to draw definitive conclusions from the evaluation. This was the difficulty experienced by the evaluation in collecting and obtaining some of the requested data form some program partners in the formats required for inclusion in the evaluation. The conduction of data collection across multiple sites from a distant location for the majority of the demonstration period placed excessive responsibilities on an already over-burdened project staff. Although the CETE-based staff in this project exhibited an exceptionally cooperative attitude, the unavoidable off-site monitoring functioned as a somewhat limiting factor in this evaluation in that there was a minimum of direction and little training available in using the various data collection methods that were either not developed or not utilized.

Summary of Results:

The following statements provide summary and discussion of key findings from the evaluation of project context, input, process, and product.

Context - The extent to which the goals and philosophy of the project were shared by key project personnel and participants was found to be as follows:

Areas of Consensus: There was a good deal of consensus about program goals among the project director, OSB & CT representatives, union representatives and project specialists. All highlighted the importance of the instruction as a means for mastery of those job-specific basic skills identified by the DELTA literacy task analyses process and

participants. All saw the purpose of the program as a demonstration of the ability of such instruction to enable participants to better perform in technical skill courses and thus better their employment conditions and tenure.

Areas of divergence: The main areas of divergence were evidenced during comparisons of participant and instructor interview responses and actions. Although participants expressed feelings of improved self-confidence after course completion, few mentioned any improvement in their employment conditions or ability to perform job or job training tasks more effectively as a result of their instructional experiences. Instructors seemed more comfortable delivering traditional basic skills materials than creating customized job-specific functionally contextual applied basic skills instruction that would transfer to job performance. This resulted in a minimum of development of the type of materials that had been originally proposed.

These observations should not be taken to mean that participants did not improve or that staff were not doing their jobs. Participants expressed indications that their improved self-confidence would enable them to continue to learn--technical skills or any other skills they felt were necessary for personal betterment. They perceived themselves to be learning skills they could apply in the workplace and in training courses and were having their needs met. Most participants were satisfied with their experiences, sometimes because of instructor personal attention.

It is likely that instructors will maintain whatever learning goals they have used previously in academic settings. It may be, however, that with development of better preservice and inservice training sessions, with more rigorous monitoring of field activities, and with the inclusion in the curriculum of instructor scripts delineating specific objectives and expectations for delivery, this philosophical divergence might have been alleviated.

Input - The availability to the project of resources during development and implementation and to what extent they were effectively used was found to be as follows:

Strengths and Weaknesses: Project special hire instructor and CETE project staff qualifications and previous experiences were rich and highly professional; they provided a definite enhancement to the program overall. Criteria might be derived from a composite profile of the qualifications and background of these key personnel for use as hiring guidelines for project or program institutionalization or replication.

Instructor training sessions proved to be somewhat inadequate. Although the information disseminated and presented was appropriate and plentiful, the lack of actual hands-on training in the special techniques required for developing customized training materials seems to have resulted in non-performance of this task by instructors or by confused, minimal performance at best. One suggestion is to provide instructors with pre-service training in literacy task analyses techniques and in functional context curriculum development so that they more fully understand the philosophy of this approach and have ample opportunity to practice the methodology and procedures associated with curriculum design and scripting out units of instruction.

The input of participants in the "participatory" process for selecting course content seemed to be only partially effective. Participants appeared to be "led" by instructor preferences for course topic content and learning styles did not seem to be addressed after identification.

The curriculum materials and delivery appeared to be one of the project's weak spots. Although CETE staff performed their project duties as stated in the proposal, there was no one person who oversaw activities on a daily basis, due to time constraints. The evaluator was the only person who visited sites to observe courses in action, to determine what activities were taking place and to offer suggestions for improvements. A full-time

project monitor who visited sites regularly to observe, report, and document activities and data might have helped to resolve this problem.

Process - The extent to which program development and observed instruction were congruent with program goals and research on instructional effectiveness follows:

Areas of Convergence and Divergence: Learner engaged time was quite high and participants spent 75%-85% of their time in the classroom actually participating in skill building activities. Both instructors and participants appeared motivated to take full benefit of instruction time and took pride in efforts made.

The quality of instruction was good overall. Four of the six instructors observed appeared to be engaged in "reciprocal learning" with the participants and displayed a caring attitude and willingness to assist participants in achieving their goals. Evidence varied from instructor to instructor, but an ability to demonstrate the thinking processes necessary for transferable or applied basic skills to be taught effectively was evidenced in some instructional delivery.

Plans for project management, selection and recruitment of participants, and so on, were well-designed, but fell short of the effectiveness they might have had in implementation due to insufficient timely communications and/or monitoring of activities by all staff and partners. For example:

- when classes were poorly attended, instructors often failed to take the time to notify CETE or union facility representatives with attendance records until the 12-week class period had ended;

- when instructors did not initially produce the customized instruction that was proposed, despite preservice and inservice trainings in appropriate techniques,

none of the CETE staff checked on the materials being produced, conducted additional training, or reported being aware of the deficiencies until the evaluator visited and reported findings to them during the second cycle of instruction;

- when the evaluator reported instructional problems at various sites to CETE, in interim evaluation reports submitted after each site visit/observation, information appears not to have been acted upon to correct instructional weaknesses and extreme variations in topics;

- when, in several locations, union partners needed more lead time, or had to change scheduled Saturday morning classes (availability to teach on Saturday mornings being one of the major criteria for hiring the part-time project special hire teachers) to week-night classes, in order generate appropriate numbers of participants, this information was not communicated to CETE in time to allow for informing potential instructors of this possibility during the interview/ hiring process;

- when CETE obtained commitment from instructors to travel to a location and arranged conveniently scheduled class times with them, local union representatives sometimes received notification of the schedule within two or three weeks of proposed class start-up dates;

- when union and OSB & CT representatives were asked to collect indicators of improved job or technical training performance from participants and union trainers for the evaluation at initial and mid-project meetings, CETE appeared not to have informed instructors of this need, not to have followed through with the union partners, and not to have incorporated it into their data collection procedures.

It is difficult to separate process from input in these situations; however, had more time been spent attending to project activities by each project staff member at all levels and across partners, the effectiveness of project implementation might have been greater.

Product - The impact of the program was assessed with a combination of indicators, including comments from participants, comparisons of pre- and post-assessment scores, and end-of-project meeting responses from key personnel representing both the education and labor partners. A summary of results follows.

Private sector organizations in the business and industry community normally evaluate training on four levels. Because workplace literacy programs are directly related to assisting workers and trainees attain career goals by meeting job requirements and improving performance on job and job training tasks, it is appropriate to measure program outcomes using this yardstick.

Level I - does the proposed program match with an identified organizational need? In this case, the project program was desired by the partnering labor organizations and OSB & CT, to enable their apprentice and journeyman members to master and complete craft technical training courses, improve employment opportunities, and function better on-the-job through improved workplace applications of basic skills. The grant applications shows that specific job tasks and special needs of each critical craft training were identified and targeted. The job training tasks and requirements were carefully selected and analyzed through the DACUM Enhanced Literacy Task Analysis technique, from which the curriculum was then to be developed.

Level II - do the participants selected for training master the content of the training program? Although only minimal gains were documented by pre-/post-assessment scores, post-program statements by participants provide a moderate amount of evidence that

participants mastered content of those courses for which this data was collected. Other considerations which cast doubt on the conclusiveness of "mastery of content" are: 1.), that the pre-/post-assessment instruments were not correlated to the course objectives in that they measure academic basic skills and not job-specific basic skills; and, 2.), that the course materials were primarily academic or "soft-skilled" in nature and not the job-specific functionally contextual curricula proposed. These two program content deviations from what was proposed to meet the identified needs (see *Level I* above), result in an inability to determine if *Level II* criteria have, in fact, been met.

Level III - do those participants who master training demonstrate improved job performance in areas identified as critical to show positive transfer of learning? Anecdotal comments from participants and information reported by key project personnel at the end-of-project meeting on March 13, 1995, indicate no significant changes in trainee performance. Of those participants who cited improvements, few identified specific observable, behaviors that clearly demonstrate positive transfer of course content to job training or job tasks.

Level IV - does impact on performance lead to demonstrable cost benefits, i.e., money saved or generated, by the positive change in employee/ trainee behavior? In this case, neither OSB & CT nor local union representatives reported indications of positive impact via individual behavioral indicators for technical training classes or job tasks, performance appraisals, or supervisor/trainer ratings; nor did any project staff among the partnering organizations cross-reference these with the instructional objectives of the courses. No data exists, therefore, for determining the possible cost benefits derived from participation in the program-- either by participants, as measured by improved job performance or opportunities, or by the unions through reduced training hours or higher levels of mastery achieved by their members who participate in such programs. To the knowledge of the evaluator, the proposed control groups for each city were not established by CETE or OSB & CT or local unions during program operations within the funding period.

Therefore, there is also no data to provide evidence of higher training retention rates, mastery of training rates, or longer/higher-paying employment by program participants than by non-program participants in the same geographical regions.

When programs are underwritten by federal funding, it is viewed in a positive way to apply such monies to value-added training for an organizations workers, or in this case, members and trainees. When an organization does not elect to invest its own funds in continued human resource development (*i.e.*, the program) at this level of commitment beyond the funded period, it indicates that such training has not become an organizational priority. In taped conversations at the end-of-project meeting of representatives from participating local construction craft unions from across the State of Ohio, none reported decisions to institutionalize and replicate the demonstration project without additional funding from a public source. This is a strong indication that the program is not viewed as one that adds value to the participating labor organizations.

Conclusions and Recommendations

Based on the results of this evaluation, the following conclusions and recommendations concerning stated grant goals are offered.

There is a moderate amount of evidence indicating:

- evidence that approximately 360 participating workers' job-specific basic skills have been increased to the levels needed for [union-sponsored] technical skills enhancement training courses through

  - provision of adult literacy and other adult basic skills services and activities to upgrade or update the basic skills of adult workers in accordance with changes in workplace requirements, technology, products, or processes, as documented in DACUM Enhanced Literacy Task Analysis (DELTA) conducted with union workers and their employers;
  - development of assessment and evaluation activities, *i.e.*, qualitative and quantitative tools to measure basic skills growth and subsequent placement outcomes;
  - provision of instruction for improvement of the competency of adult workers in speaking, listening, reasoning, and problem solving; and,
  - provision of educational counseling, transportation, and child care services for adult workers during non-working hours while the workers participate in the project.

- evidence of increased participating workers' enrollment and completion of skill enhancement courses through

- development and use of record-keeping and documentation systems, including collection, interpretation, and reporting of data on program development and implementation of activities and on individual progress of participants; and,
- development and use of appropriate processes for participant recruitment and selection, class scheduling, development of individual education plans, curriculum delivery, pre-and post-test assessment, and instructor training and support, that are academically and organizationally sound and that match with program goals.

- evidence of program information dissemination at all levels, including the national level, through the assistance of the AFL-CIO Education Department and conference presentations, such as those of the American Society of Training and Development, the American Vocational Association, and the Commission on Adult Basic Education.

Recommendations:

1. Conduct more rigorous and comprehensive pre-service trainings with instructors to ensure that they properly incorporate, develop and deliver customized, job-specific functionally contextual workplace applied basic skills curriculum as program instruction. Development and use of scripted instructional unit instructor guidelines can also provide on-going support for appropriate use and understanding of materials and for monitoring beyond pre-service and inservice sessions.

2. Provide additional data demonstrating reports and queries to employers and trainers and involvement with participant's supervisors to obtain feedback about technical training mastery and/or improved attendance records and improved job performance of participants.

3. Allocate more staff time to communication and monitoring of all project activities or budget and hire a full-time program monitor to attend to these tasks.

4. Work more closely with information dissemination agencies to ensure that program receives more attention and national recognition. This could strengthen and support desire of partnering local unions to allocate funding for program institutionalization or replication, based on lessons learned from partnership experience in project.

There is little or no evidence demonstrating:

- evidence of a smooth flow of instructional activities within the curricula, reflecting a collaborative model of instruction, in which workers themselves participate, and sound developmental approach to mastery of those literacy skills necessary for competent performance of identified job or job training tasks; and,

- evidence of an improved job placement record of participating workers in comparison to that of a control group, as documented for both participants and a matched group of non-participants in each city.

Recommendations:

1. Ensure that the information gathered from the DELTA or other literacy task analysis procedures is made available to all instructors and, perhaps, that they are trained in DACUM/DELTA techniques as well, in order to gather additional site-specific information about craft job or training task applied basic skills.

2. Carefully analyze and evaluate instructor training materials and activities to determine which topics require revision or addition of more hands-on practical applications in order to ensure that instructors master training content presented. Conduct field investigations and provide feedback on a continuing basis after initial and inservice trainings are completed to monitor and facilitate growth of instructors in areas of newly-acquired curriculum development techniques. Add curriculum development sample or demonstration process to instructor interview/screening for hiring.

3. Work jointly with labor partners to ensure that proposed plan for demonstrating benefits of program for participants vs. non-participants (*i.e.*, control groups) becomes a reality. Such evidence, if conclusive, would do much to promote continuation and expansion of similar programs throughout the state and throughout the country.

Appendix A:

Pre-Assessment and Post-Assessment Data Analysis

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	1	4	5	6	8	9	10	11	12	14
Pretests										
ABLE Number Operations	77%	68%	54%	54%	77%	59%	81%	89%	68%	35%
ABLE Problem Solving	99%	72%	67%	85%	85%	97%	81%	98%	81%	99%
ABLE Vocabulary	97%	95%	89%	99%	92%	82%	92%	99%	99%	
ABLE Reading	98%	98%	98%	90%	98%	94%	98%	81%	94%	
TALS Document	320	320	280	310	320	250	290	250	330	
TALS Prose	390	310	330	330	310	350	330	330	330	
Cloze Level 1	67%	51%	49%	49%	53%	40%	42%	63%	35%	70%
Cloze Level 2	63%	54%	49%	46%	51%	49%	54%	55%	40%	60%
Learning Styles Instrument										
Visual Language	22	34	20	32	28	22	34	40	26	
Visual Numeracy	16	26	34	34	32	40	36	40	32	
Auditory Language	26	20	36	30	36	28	30	26	30	
Auditory Numerical	28	30	34	30	34	38	36	36	30	
Auditory-visual-kinsethetic	26	38	34	38	30	40	36	36	30	40
Individual Learner	26	26	38	28	20	22	32	32	26	36
Group Learner	18	38	26	32	36	40	28	32	22	24
Expressiveness-oral	20	20	28	34	32	26	34	34	26	
Expresssiveness-written	26	32	22	28	18	16	26	30	24	24
Self Assessment: Need to Learn										
Communicating										x
Teamwork										
Math	x	x	x	x	x	x		x	x	
Reading		x			x					x
Writing				x						x
Spelling				x					x	x
Solving Problems		x	x		x	x	x	x	x	
Listening							x			
Speaking		x								x
Job Skills								x		
Studying		x	x					x	x	

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	1	4	5	6	8	9	10	11	12	14
Posttests										
ABLE Number Operations	95%	93%	42%	76%	72%	70%	85%	79%	52%	65%
ABLE Problem Solving	99%	66%	55%	91%	62%	84%	78%	86%	88%	99%
TALS Document	300	300	260	370	290	330	300	320	280	
TALS Prose	390	290	310	350	330	340	320	370	340	
Skills Learned: Self-report	**n=12**									**n=5**
Writing	1									2
Spelling										3
Expressing an Opinion	4									4
Problem Solving	7									3
Reading to Remember	5									2
Reading for Details	4									4
Reading for Analyzing Information	5									3
Analyzing information on Charts	3									1
Working with basic math	8									3
Working with fractions	9									3
Working with decimals	8									1
Working with percents	7									
Understanding how I learn best	1									5
Study Skills	3									2
Pay Attention to Detail										
Speed in Math										
Recording and Retrieving										
Computation										
Geometry										
Determining Outcomes										
ReadingComprehension										
Pretests/Posttests Gains										
ABLE Number Operations	18%	25%	-12%	22%	-5%	11%	4%	-10%	-16%	30%
ABLE Problem Solving	0%	-6%	-12%	6%	-23%	-13%	-3%	-12%	7%	0%
TALS Document	-20	-20	-20	60	-30	80	10	70	-50	0
TALS Prose	0	-20	-20	20	20	-10	-10	40	10	0

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	15	16	19	20	21	22	23	24	25	26
Pretests										
ABLE Number Operations	65%	35%	88%	69%	18%	84%	51%	51%	76%	29%
ABLE Problem Solving	99%	82%	95%	90%	25%	93%	63%	49%	63%	19%
ABLE Vocabulary										
ABLE Reading										
TALS Document			370	350	270	340	350	350	350	330
TALS Prose			370	370	330	370	350	320	310	330
Cloze Level 1	60%	41%								
Cloze Level 2	54%	42%								
Learning Styles Instrument										
Visual Language										
Visual Numeracy	40	36								
Auditory Language	32	36								
Auditory Numerical	22	34								
Auditory-visual-kinsethetic	38	32								
Individual Learner										
Group Learner	38	36								
Expressiveness-oral	20									
Expresssiveness-written										
Self Assessment: Need to Learn										
Communicating	x	x	x	x	x	x	x	x	x	x
Teamwork										
Math	x	x	x	x			x		x	
Reading	x									
Writing			x		x			x		x
Spelling	x	x	x	x		x			x	x
Solving Problems	x									
Listening										
Speaking	x			x	x					
Job Skills			x			x		x	x	
Studying				x	x			x	x	x

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	15	16	19	20	21	22	23	24	25	26
Posttests										
ABLE Number Operations	96%	24%	95%	91%	32%	76%	62%	69%	72%	23%
ABLE Problem Solving	98%	73%	97%	99%	81%	63%	81%	63%	93%	42%
TALS Document			350	330	270	340	370	310	350	270
TALS Prose			370	370	330	390	370	340	360	320
Skills Learned: Self-report			n=20							
Writing										
Spelling										
Expressing an Opinion										
Problem Solving										
Reading to Remember										
Reading for Details										
Reading for Analyzing Information										
Analyzing Information on Charts										
Working with basic math										
Working with fractions										
Working with decimals										
Working with percents										
Understanding how I learn best										
Study Skills										
Pay Attention to Detail			1							
Speed in Math			9							
Recording and Retrieving			5							
Computation			11							
Geometry			7							
Determining Outcomes			7							
ReadingComprehension			5							
Pretests/Posttests Gains										
ABLE Number Operations	31%	-11%	7%	22%	14%	-8%	11%	18%	-4%	-6%
ABLE Problem Solving	-1%	-9%	2%	9%	56%	-30%	18%	14%	30%	23%
TALS Document	0	0	-20	-20	0	0	20	-40	0	-60
TALS Prose	0	0	0	0	0	20	20	20	50	-10

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	27	28	29	30	31	33	34	35	36	37
Pretests										
ABLE Number Operations	29%	76%	95%	32%	47%	80%	72%	69%	95%	76%
ABLE Problem Solving	19%	95%	84%	16%	46%	38%	87%	99%	99%	93%
ABLE Vocabulary										
ABLE Reading										
TALS Document	260	340	350	340	370	310	370	340	350	350
TALS Prose	280	350	280	330	370	370	370	350	390	390
Cloze Level 1										
Cloze Level 2										
Learning Styles Instrument										
Visual Language										
Visual Numeracy										
Auditory Language										
Auditory Numerical										
Auditory-visual-kinsethetic										
Individual Learner										
Group Learner										
Expressiveness-oral										
Expresssiveness-written										
Self Assessment: Need to Learn										
Communicating	x	x								
Teamwork										
Math	x	x	x	x						
Reading			x	x	x		x		x	x
Writing			x			x	x	x		x
Spelling		x							x	
Solving Problems										
Listening										
Speaking							x	x	x	
Job Skills	x	x		x						
Studying		x	x	x					x	x

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	27	28	29	30	31	33	34	35	36	37
Posttests										
ABLE Number Operations	26%	84%	88%	51%	72%	91%	51%	98%	99%	98%
ABLE Problem Solving	25%	99%	81%	60%	68%	56%	87%	99%	99%	99%
TALS Document	270	350	320	300	390	310	390	400	370	400
TALS Prose	320	340	340	320	370	310	370	360	390	390
Skills Learned: Self-report										
Writing										
Spelling										
Expressing an Opinion										
Problem Solving										
Reading to Remember										
Reading for Details										
Reading for Analyzing Information										
Analyzing information on Charts										
Working with basic math										
Working with fractions										
Working with decimals										
Working with percents										
Understanding how I learn best										
Study Skills										
Pay Attention to Detail										
Speed in Math										
Recording and Retrieving										
Computation										
Geometry										
Determining Outcomes										
ReadingComprehension										
Pretests/Posttests Gains										
ABLE Number Operations	-3%	8%	-7%	19%	25%	11%	-21%	29%	4%	22%
ABLE Problem Solving	6%	4%	-3%	44%	22%	18%	0%	0%	0%	6%
TALS Document	10	10	-30	-40	20	0	20	60	20	50
TALS Prose	40	-10	60	-10	0	-60	0	10	0	0

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	38	44	45	46	47	48	49	50	51	52
Pretests										
ABLE Number Operations						92%	31%	62%	92%	99%
ABLE Problem Solving						99%	40%	40%	88%	99%
ABLE Vocabulary										
ABLE Reading										
TALS Document	330	340	370	370	370	340	300	230	350	370
TALS Prose	340	360	370	390	390	390	370	300	390	370
Cloze Level 1	68%	70%	70%	70%	38%					
Cloze Level 2	70%	70%	70%	69%	70%					
Learning Styles Instrument										
Visual Language	28	32	38	38	28					
Visual Numeracy	34	32	22	38	30					
Auditory Language	28	20	24	22	24					
Auditory Numerical	38	38	30	34	28					
Auditory-visual-kinsethetic	24	38	40	38	40					
Individual Learner	32	38	36	22	26					
Group Learner	26	14	32	40	26					
Expressiveness-oral	26	30	30	36	26					
Expresssiveness-written	30	16	16	26	30					
Self Assessment: Need to Learn										
Communicating		x		x	x			x		x
Teamwork					x					
Math	x			x	x		x			x
Reading		x			x					
Writing		x				x			x	
Spelling		x							x	
Solving Problems	x		x		x					
Listening					x					
Speaking		x			x		x			
Job Skills					x					x
Studying			x		x					x

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	38	44	45	46	47	48	49	50	51	52
Posttests										
ABLE Number Operations						95%	54%	69%	98%	99%
ABLE Problem Solving						99%	54%	40%	93%	99%
TALS Document	330	310	330	370	370	330	290	290	370	320
TALS Prose	340	390	370	370	390	370	370	370	390	390
Skills Learned: Self-report	**n=10**									
Writing	1									
Spelling										
Expressing an Opinion	1									
Problem Solving	5									
Reading to Remember	1									
Reading for Details	3									
Reading for Analyzing Information	3									
Analyzing information on Charts	2									
Working with basic math	1									
Working with fractions	4									
Working with decimals	3									
Working with percents	4									
Understanding how I learn best	1									
Study Skills	2									
Pay Attention to Detail										
Speed in Math										
Recording and Retrieving										
Computation										
Geometry										
Determining Outcomes										
ReadingComprehension										
Pretests/Posttests Gains										
ABLE Number Operations	0%	0%	0%	0%	0%	3%	23%	7%	6%	0%
ABLE Problem Solving	0%	0%	0%	0%	0%	0%	14%	0%	5%	0%
TALS Document	0	-30	-40	0	0	-10	-10	60	20	-50
TALS Prose	0	30	0	-20	0	-20	0	70	0	20

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	54	55	56	57	58	59	60	62	65	66
Pretests										
ABLE Number Operations	88%	31%	80%	99%	98%	69%	98%	86%	99%	62%
ABLE Problem Solving	99%	43%	81%	72%	93%	99%	95%	95%	97%	86%
ABLE Vocabulary									96%	99%
ABLE Reading									92%	83%
TALS Document	350	350	370	350	370	330	340	370		
TALS Prose	370	350	400	390	370	370	340	330		
Cloze Level 1					58%	37%	65%	65%	65%	56%
Cloze Level 2					76%	69%	64%	69%	52%	55%
Learning Styles Instrument										
Visual Language					32	22	24	28	23	28
Visual Numeracy					34	24	28	36	25	32
Auditory Language					16	38	28	22	32	23
Auditory Numerical					24	32	26	28	37	18
Auditory-visual-kinsethetic					26	34	28	30	25	24
Individual Learner					34	28	28	30	30	24
Group Learner					24	22	26	34	36	26
Expressiveness-oral					14	28	20	16	26	24
Expresssiveness-written					22	16	26	34	16	12
Self Assessment: Need to Learn										
Communicating		x	x		x	x	x	x		
Teamwork				x		x	x	x		
Math			x							
Reading									x	
Writing						x			x	
Spelling				x		x		x	x	
Solving Problems			x				x	x		
Listening	x						x			
Speaking			x		x	x	x	x		
Job Skills										
Studying	x	x	x					x		

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	54	55	56	57	58	59	60	62	65	66
Posttests										
ABLE Number Operations	88%	62%	91%	98%	91%	84%	99%	72%	99%	59%
ABLE Problem Solving	99%	68%	99%	81%	63%	99%	93%	74%	98%	78%
TALS Document	360	330	390	350	390	320	310	330		
TALS Prose	320	370	390	360	390	350	340	390		
Skills Learned: Self-report					**n=6**				**n=19**	
Writing					3					
Spelling					3					
Expressing an Opinion					1				3	
Problem Solving					3				12	
Reading to Remember					1				2	
Reading for Details					1				3	
Reading for Analyzing Information					1				4	
Analyzing information on Charts					2				5	
Working with basic math					1				3	
Working with fractions					1				13	
Working with decimals					1				12	
Working with percents					1				11	
Understanding how I learn best					2				3	
Study Skills					2				1	
Pay Attention to Detail										
Speed in Math										
Recording and Retrieving										
Computation										
Geometry										
Determining Outcomes										
ReadingComprehension										
Pretests/Posttests Gains										
ABLE Number Operations	0%	31%	11%	-1%	-7%	15%	1%	-14%	0%	-3%
ABLE Problem Solving	0%	25%	18%	9%	-30%	0%	-2%	-21%	1%	-8%
TALS Document	10	-20	20	0	20	-10	-30	-40	0	0
TALS Prose	-50	20	-10	-30	20	-20	0	60	0	0

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	67	69	70	71	72	73	74	75	76	77
Pretests										
ABLE Number Operations	57%	53%	94%	99%	72%	97%	77%	94%	90%	90%
ABLE Problem Solving	90%	86%	86%	99%	90%	94%	90%	94%	97%	90%
ABLE Vocabulary	80%	91%	64%	99%	99%	98%	88%	99%	88%	80%
ABLE Reading	92%	92%	59%	97%	97%	88%	92%	92%	92%	99%
TALS Document										
TALS Prose										
Cloze Level 1	53%	49%	65%	67%	65%	67%	56%	65%	53%	65%
Cloze Level 2	61%	60%	43%	61%	77%	64%	60%	54%	67%	61%
Learning Styles Instrument										
Visual Language	28	34	25	24	30	24	18	28	34	20
Visual Numeracy	40	36	34	28	29	20	24	32	28	34
Auditory Language	33	20	35	32	22	30	36	25	24	30
Auditory Numerical	40	34	36	30	31	22	30	16	30	32
Auditory-visual-kinsethetic	34	33	30	34	31	28	36	34	32	36
Individual Learner	32	36	20	20	31	26	26	20	30	18
Group Learner	26	29	36	30	16	26	26	31	38	36
Expressiveness-oral	34	36	26	28	29	22	32	20	16	24
Expresssiveness-written	16	16	14	20	18	18	18	18	20	22
Self Assessment: Need to Learn										
Communicating								x		
Teamwork										
Math		x		x					x	x
Reading	x						x			
Writing	x						x			
Spelling	x	x			x			x		
Solving Problems	x		x						x	
Listening										
Speaking	x									
Job Skills	x			x						
Studying	x									x

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	67	69	70	71	72	73	74	75	76	77
Posttests										
ABLE Number Operations	67%	71%	87%	94%	98%	99%	56%	87%	82%	94%
ABLE Problem Solving	52%	99%	66%	98%	78%	93%	80%	94%	97%	78%
TALS Document										
TALS Prose										
Skills Learned: Self-report										
Writing										
Spelling										
Expressing an Opinion										
Problem Solving										
Reading to Remember										
Reading for Details										
Reading for Analyzing Information										
Analyzing information on Charts										
Working with basic math										
Working with fractions										
Working with decimals										
Working with percents										
Understanding how I learn best										
Study Skills										
Pay Attention to Detail										
Speed in Math										
Recording and Retrieving										
Computation										
Geometry										
Determining Outcomes										
ReadingComprehension										
Pretests/Posttests Gains										
ABLE Number Operations	10%	18%	-7%	-5%	26%	2%	-21%	-7%	-8%	4%
ABLE Problem Solving	-38%	13%	-20%	-1%	-12%	-1%	-10%	0%	0%	-12%
TALS Document	0	0	0	0	0	0	0	0	0	0
TALS Prose	0	0	0	0	0	0	0	0	0	0

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	78	79	80	81	82	83	84	85	89	90
Pretests										
ABLE Number Operations	81%	81%	81%	99%	94%					
ABLE Problem Solving	97%	77%	72%	99%	99%					
ABLE Vocabulary	98%	98%	91%	99%	99%					
ABLE Reading	99%	92%	88%	97%	99%					
TALS Document						350	350	350	330	370
TALS Prose						390	390	370	300	390
Cloze Level 1	61%	70%	63%	67%	56%					
Cloze Level 2	49%	70%	66%							
Learning Styles Instrument										
Visual Language	26	36	12	28	29					
Visual Numeracy	3	28	12	22	30					
Auditory Language	34	16	40	25	30					
Auditory Numerical	34	30	36	30	30					
Auditory-visual-kinsethetic	36	38	36	34	35					
Individual Learner	16	32	26	28	25					
Group Learner	38	16	18	30	25					
Expressiveness-oral	28	14	32	28	29					
Expresssiveness-written	14	34	18	20	12					
Self Assessment: Need to Learn										
Communicating						x				
Teamwork						x				
Math	x	x	x			x			x	
Reading			x	x		x			x	
Writing			x	x	x	x		x	x	
Spelling			x			x		x	x	
Solving Problems	x					x	x			
Listening						x				
Speaking						x				
Job Skills						x				
Studying	x				x	x			x	

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	78	79	80	81	82	83	84	85	89	90
Posttests										
ABLE Number Operations	99%	87%	55%	98%	94%					
ABLE Problem Solving	96%	88%	48%	99%	88%					
TALS Document						350	350	340	370	370
TALS Prose						350	370	370	310	350
Skills Learned: Self-report										
Writing										
Spelling										
Expressing an Opinion										
Problem Solving										
Reading to Remember										
Reading for Details										
Reading for Analyzing Information										
Analyzing information on Charts										
Working with basic math										
Working with fractions										
Working with decimals										
Working with percents										
Understanding how I learn best										
Study Skills										
Pay Attention to Detail										
Speed in Math										
Recording and Retrieving										
Computation										
Geometry										
Determining Outcomes										
ReadingComprehension										
Pretests/Posttests Gains										
ABLE Number Operations	18%	6%	-26%	-1%	0%	0%	0%	0%	0%	0%
ABLE Problem Solving	-1%	11%	-24%	0%	-11%	0%	0%	0%	0%	0%
TALS Document	0	0	0	0	0	0	0	-10	40	0
TALS Prose	0	0	0	0	0	-40	-20	0	10	-40

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	91	92	93	94	98	99	102	103	104	105
Pretests										
ABLE Number Operations						84%	51%	65%	80%	40%
ABLE Problem Solving						99%	35%	72%	97%	27%
ABLE Vocabulary										
ABLE Reading										
TALS Document	370	370	310	290	350	330		340	350	270
TALS Prose	340	350	280	330	330	370	280	290	300	280
Cloze Level 1						65%	53%	56%	51%	44%
Cloze Level 2						70%		60%	66%	57%
Learning Styles Instrument										
Visual Language						22	28	36	28	26
Visual Numeracy						32	20	32	28	24
Auditory Language						40	22	18	38	26
Auditory Numerical						16	32	22	34	36
Auditory-visual-kinsethetic						40	36	40	32	34
Individual Learner						30	28	28	28	38
Group Learner						36	20	20	26	20
Expressiveness-oral						32	32	26	30	30
Expresssiveness-written						28	10	26	18	18
Self Assessment: Need to Learn										
Communicating			x			x	x		x	x
Teamwork						x			x	x
Math	x						x			x
Reading						x	x		x	x
Writing		x	x		x	x	x		x	x
Spelling				x	x	x	x			x
Solving Problems	x					x			x	
Listening						x	x		x	x
Speaking	x		x		x	x	x			x
Job Skills	x					x				x
Studying					x	x	x		x	x

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	91	92	93	94	98	99	102	103	104	105
Posttests										
ABLE Number Operations						76%	62%	62%	62%	69%
ABLE Problem Solving						99%	32%	78%	93%	35%
TALS Document	350	350	330	350	350	350		280	330	300
TALS Prose	370	390	370	330	320	320	290	290	300	300
Skills Learned: Self-report										
Writing										
Spelling										
Expressing an Opinion										
Problem Solving										
Reading to Remember										
Reading for Details										
Reading for Analyzing Information										
Analyzing information on Charts										
Working with basic math										
Working with fractions										
Working with decimals										
Working with percents										
Understanding how I learn best										
Study Skills										
Pay Attention to Detail										
Speed in Math										
Recording and Retrieving										
Computation										
Geometry										
Determining Outcomes										
ReadingComprehension										
Pretests/Posttests Gains										
ABLE Number Operations	0%	0%	0%	0%	0%	-8%	11%	-3%	-18%	29%
ABLE Problem Solving	0%	0%	0%	0%	0%	0%	-3%	6%	-4%	8%
TALS Document	-20	-20	20	60	0	20	0	-60	-20	30
TALS Prose	30	40	90	0	-10	-50	10	0	0	20

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	106	107		average	median	mode
Pretests						
ABLE Number Operations	80%	50%		71.55%	77.00%	99.00%
ABLE Problem Solving	99%	58%		78.97%	90.00%	99.00%
ABLE Vocabulary				92.69%	96.50%	99.00%
ABLE Reading				92.27%	93.00%	92.00%
TALS Document	350	280		333.11	340.00	350.00
TALS Prose	390	290		346.77	350.00	370.00
Cloze Level 1	67%	65%		57.89%	61.00%	65.00%
Cloze Level 2	75%	60%		60.29%	60.50%	70.00%
Learning Styles Instrument						
Visual Language	32	36		28.17	28.00	28.00
Visual Numeracy	38	36		29.80	32.00	32.00
Auditory Language	26	14		27.80	28.00	30.00
Auditory Numerical	36	30		30.73	30.50	30.00
Auditory-visual-kinsethetic	34	34		33.82	34.00	34.00
Individual Learner	38	36		28.51	28.00	26.00
Group Learner	18	26		28.07	26.00	26.00
Expressiveness-oral	16	18		26.33	28.00	26.00
Expresssiveness-written	36	26		21.63	20.00	18.00
Self Assessment: Need to Learn				**n=107**		
Communicating		x		32		
Teamwork				9		
Math				36		
Reading	x	x		25		
Writing	x	x		33		
Spelling				31		
Solving Problems	x	x		25		
Listening	x	x		11		
Speaking		x		25		
Job Skills				16		
Studying	x	x		34		

Building Essential Skills
Pre/Post Assessment
Data Analysis

Participants	106	107	average	median	mode
Posttests			*average*	*median*	*mode*
ABLE Number Operations	91%	76%	76.88%	82.00%	98.00%
ABLE Problem Solving	95%	95%	80.43%	87.00%	99.00%
TALS Document	350	330	334.10	330.00	350.00
TALS Prose	350	370	351.77	360.00	370.00

Skills Learned: Self-report	Total
Writing	7
Spelling	6
Expressing an Opinion	13
Problem Solving	30
Reading to Remember	11
Reading for Details	15
Reading for Analyzing Information	16
Analyzing information on Charts	13
Working with basic math	16
Working with fractions	30
Working with decimals	25
Working with percents	23
Understanding how I learn best	12
Study Skills	10
Pay Attention to Detail	1
Speed in Math	9
Recording and Retrieving	5
Computation	11
Geometry	7
Determining Outcomes	7
ReadingComprehension	5

Pretests/Posttests Gains			average	min	max
ABLE Number Operations	11%	26%	4.35%	-26%	31%
ABLE Problem Solving	-4%	37%	1.20%	-38%	56%
TALS Document	0	50	0.73	-60	80
TALS Prose	-40	80	3.78	-60	90

Appendix B:

Participant Data

Building Essential Skills
Participant Data

Participants	1	2	3	4	5	6	7	8	9	10
Age	22	32	29	30	19	23	28	23	33	31
Ethnicity	w	w	w		w	h	b	w	h	b
Gender	m	f	m	m	m	m	m	m	m	m
Single Head of Household	x	x	x	x	x			x	x	
Limited English Proficiency				x		x				
HS Graduate	x	x	x	x	x	x	x	x		x
GED									x	
College Degree										
College Courses								x		x
Job Certification										
Trade School /Military		x	x		x	x	x			x
Employed	x	x		x	x	x	x	x	x	x
No. Years Worked in Trade	4.5	4	3		6.5	3.5	3.5	3.5	3	0.5
Attendance (in hours)	54	40.5	22.5	49.5	40.5	54	31.5	45	49.5	18

Building Essential Skills
Participant Data

Participants	11	12	13	14	15	16	17	18	19	20
Age	31	27	38	38	45	31	47	39	48	44
Ethnicity	b	w	w	w	w	b	w	w	w	h
Gender	m	m	m	m	m	m	m	m	m	m
Single Head of Household		x						x	x	
Limited English Proficiency								x		x
HS Graduate	x	x						x	x	
GED										x
College Degree										
College Courses	x									
Job Certification								x		
Trade School /Military		x						x	x	x
Employed	x	x						x	x	x
No. Years Worked in Trade	7	7	9	20	21	4.5	29	7	25	26
Attendance (in hours)	54	36	45	45	40.5	40.5	45			

Building Essential Skills
Participant Data

Participants	21	22	23	24	25	26	27	28	29	30
Age	34	36	42	35	46	33	39	35	34	25
Ethnicity	w	w	w	w	ai	w	w	w	w	w
Gender	m	m	m	m	f	m	m	m	m	m
Single Head of Household	x			x	x	x	x			x
Limited English Proficiency	x								x	
HS Graduate	x	x	x	x	x	x	x	x	x	x
GED										
College Degree										
College Courses										
Job Certification		x			x			x	x	
Trade School /Military		x	x	x	x			x		
Employed	x	x	x	x	x	x	x	x	x	x
No. Years Worked in Trade		9.5	0.2	15.5	0.25	6	26	4	0.5	2.5
Attendance (in hours)										

Building Essential Skills
Participant Data

Participants	31	32	33	34	35	36	37	38	39	40
Age	32	30	41	51	35	33	35	30	33	24
Ethnicity	w	w	w	w	w	w	w	w	w	w
Gender	m	m	m	m	m	m	m	m	m	m
Single Head of Household			x		x			x	x	x
Limited English Proficiency				x						x
HS Graduate	x	x	x		x	x	x	x	x	x
GED										
College Degree										
College Courses										
Job Certification		x		x						
Trade School /Military	x	x	x	x	x	x		x	x	x
Employed	x	x	x	x	x	x	x		x	x
No. Years Worked in Trade	14	9	24	20	14.5	15	0.5		3.5	4
Attendance (in hours)								31.5	31.5	9

Building Essential Skills
Participant Data

Participants	41	42	43	44	45	46	47	48	49	50
Age	23	25	27	27	33	29	29	36	31	33
Ethnicity	w	w	w	w	w	w	w	w	w	w
Gender	m	m	m	m	m	m	m	m	m	m
Single Head of Household	x		x		x		x			
Limited English Proficiency	x				x					
HS Graduate	x	x	x	x	x	x	x			
GED										
College Degree										
College Courses	x					x				
Job Certification					x		x			
Trade School /Military		x	x	x		x				
Employed	x	x	x	x		x	x			
No. Years Worked in Trade	4	4	3.5	5		4	4.5	1	1	5
Attendance (in hours)	13.5	4.5	4.5	27	27	40.5	40.5			

Building Essential Skills
Participant Data

Participants	51	52	53	54	55	56	57	58	59	60
Age	38	35	50	41		43	49	38	38	45
Ethnicity	w	w	w	w	w	w	w	w	w	w
Gender	m	m	m	m	m	f	m	m	m	m
Single Head of Household									x	
Limited English Proficiency										
HS Graduate								x	x	x
GED										
College Degree										
College Courses									x	x
Job Certification									x	
Trade School /Military										x
Employed								x	x	x
No. Years Worked in Trade	14	14	31	3	1	15	33	16	13	22
Attendance (in hours)								54	54	54

Building Essential Skills
Participant Data

Participants	61	62	63	64	65	66	67	68	69	70
Age		25	37	24	22	23	21	25	31	25
Ethnicity	w	w	b	w	w	w	w	w	w	w
Gender	m	f	m	m	m	m	m	m	m	m
Single Head of Household	x	x	x	x				x		x
Limited English Proficiency	x			x	x					
HS Graduate	x	x	x	x	x	x	x	x	x	x
GED										
College Degree										x
College Courses		x	x		x	x	x	x		x
Job Certification		x	x			x				
Trade School /Military	x	x		x	x	x		x	x	x
Employed	x	x		x	x	x	x	x	x	x
No. Years Worked in Trade	40	6		6.5	2	0.5	2.5	9	1.5	1
Attendance (in hours)	36	54	9	20	44	40	44	36	54	44

Building Essential Skills
Participant Data

Participants	71	72	73	74	75	76	77	78	79	80
Age	34	33	23	21	20	23	20	24	30	19
Ethnicity	w	w	w	w	w	w	w	w	w	w
Gender	m	m	m	m	m	m	m	m	m	m
Single Head of Household		x	x						x	x
Limited English Proficiency										
HS Graduate		x	x	x	x	x	x	x	x	x
GED	x									
College Degree										
College Courses	x	x		x			x	x	x	
Job Certification		x						x		
Trade School /Military	x	x	x	x	x	x	x	x		x
Employed	x	x	x	x	x	x	x	x	x	x
No. Years Worked in Trade	8	13	2.5	2.5	2	2.5	1.5	1	1.5	1
Attendance (in hours)	44	48	44	44	44	44	36	44	44	54

Building Essential Skills
Participant Data

Participants	81	82	83	84	85	86	87	88	89	90
Age	28	28	35	32	54	50	37	40	56	47
Ethnicity	w	w	w	w	w	w	w	w	w	w
Gender	m	m	m	m	m	m	m	m	m	m
Single Head of Household						x	x		x	x
Limited English Proficiency										
HS Graduate	x	x	x	x	x	x	x	x	x	x
GED										
College Degree	x									
College Courses	x	x	x		x		x	x		x
Job Certification			x	x	x	x	x	x	x	x
Trade School /Military	x	x	x		x	x		x		x
Employed	x	x	x	x		x	x	x	x	x
No. Years Worked in Trade	2	4	16	7	36	30	9	20	38	26
Attendance (in hours)	54	54	55	55	55	49.5	38.5	33	55	49.5

Building Essential Skills
Participant Data

Participants	91	92	93	94	95	96	97	98	99	100
Age	29	36	58	56	54	43	33	53	46	27
Ethnicity	w	w	b	w	w	w	w	w	w	w
Gender	m	m	m	m	m	m	m	m	m	m
Single Head of Household		x			x	x	x	x		x
Limited English Proficiency										
HS Graduate	x	x	x	x	x	x	x	x	x	x
GED										
College Degree										
College Courses	x	x	x	x		x	x			x
Job Certification	x		x	x	x	x	x	x	x	
Trade School /Military	x		x	x	x	x	x	x	x	
Employed	x	x	x	x	x	x	x	x	x	x
No. Years Worked in Trade	8	8	24	37	34	18	10.5	33	21	13
Attendance (in hours)	49.5	49.5	49.5	55	22	38.5	27.5	49.5	40	5

Building Essential Skills
Participant Data

Participants	101	102	103	104	105	106	107	108	109	110
Age	47	57	53	40	41	45	27	42	49	36
Ethnicity	b	w	w	w	b	w	w	w	b	w
Gender	m	m	m	m	m	m	m	m	m	m
Single Head of Household		x	x	x	x	x	x	x		
Limited English Proficiency										
HS Graduate	x	x	x	x	x	x	x	x	x	x
GED										
College Degree	x				x					
College Courses	x		x		x	x			x	x
Job Certification	x		x	x	x	x	x			
Trade School /Military	x	x	x	x	x	x	x	x		
Employed		x		x		x	x	x		x
No. Years Worked in Trade		28	24.5	20		28	6	11		
Attendance (in hours)	10	40	40	40	40	40	40	5	10	

Building Essential Skills
Participant Data

Participants	111	112	113	114	115	116	117	118	119	120
Age	31	36	28	18	26	24	40	56	32	33
Ethnicity	w	w	w	w	w	w	w	w	w	w
Gender	m	m	m	m	m	m	m	m	m	m
Single Head of Household	x				x		x		x	
Limited English Proficiency							x			
HS Graduate	x	x	x		x	x	x	x	x	x
GED				x					x	
College Degree						x				
College Courses		x	x				x		x	
Job Certification	x					x		x		
Trade School /Military		x	x		x	x			x	x
Employed	x	x		x	x	x		x		x
No. Years Worked in Trade	2	9.5	9.5	1	6.3	4.5		3		0.33
Attendance (in hours)										

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Building Essential Skills
Participant Data

Participants	121	122	123	124	125	126	127
Age	35	28	28	30	33	36	36
Ethnicity	w	w	w	w	w	b	w
Gender	m	m	m	m	m	m	m
Single Head of Household		x	x		x	x	x
Limited English Proficiency			x		x	x	
HS Graduate	x		x	x	x	x	x
GED			x				
College Degree	x						
College Courses				x			
Job Certification			x	x	x		x
Trade School /Military		x		x		x	x
Employed	x	x	x		x	x	
No. Years Worked in Trade		0.5	0.75	8.5	1	1.3	0.25
Attendance (in hours)							

Building Essential Skills
Participant Data

Participants						
	average age in years					
Age	34.72	ethnicity totals:				
			white	black	hispanic	asian
Ethnicity			113	10	3	1
			88.98%	7.87%	2.36%	0.79%
Gender	gender totals:	male=123	female=4			
		96.85%	3.15%			
Single Head of Household	single head household					
	62	48.82%				
Limited English Proficiency		limited English proficiency				
		17	13.39%			
HS Graduate	HS graduate					
	106	83.46%				
GED		GED				
		6	4.72%			
College Degree		college degree				
		6	4.72%			
College Courses		college courses				
		45	35.43%			
Job Certification		job certification				
		44	34.65%			
Trade School /Military		trade school/military service				
		79	62.20%			
Employed		employed				
		98	77.17%			
No. Years Worked in Trade		average no. yrs. worked in trade/union				
		10.57				
Attendance (in hours)	total hours attendance	average attendance in hours				
	3079	38.97	72.17%			

Appendix C:

Copies of Interim Reports Submitted to Project Director

Ohio State University
Interim Evaluation Report
Site Visits #2 and #3

Activities:

The purpose for the site visits was to obtain goal statements from participants and instructors, to gather samples of curriculum, and to observe the process of instruction. In addition, the evaluator wished to meet with the project directors and representative for the partnering unions to receive up-dated goal statements and information about the status of current and future project activities and timelines. Evaluator Philippi visited Columbus on March 4, Cleveland on March 4-5, and Toledo on March 18-19, 1994.

1. During the Columbus visit, Philippi met with Sandy Pritz, Johanna DeStefano, Susan Imel, and Tina -- from OSU, and C.J. Slanicka, a representative of the Research Center and liaison for the construction union partners. The meeting addressed project progress to date, including those classes completed, in operation, planned, and rescheduled. A computer authoring system also was demonstrated and analyzed at the meeting, and is under consideration for use by instructors and participants to collaborate on creating additional functionally contextual exercises.
2. Philippi arrived in Cleveland the evening of March 4 and met briefly with Anne Magruder, the instructor who is working with the area carpenters' union. Ms. Magruder was interviewed the following morning prior to class to provide information concerning instructor goal statements. Following the interview, Philippi traveled to the classroom site, met briefly with the union team teacher, Pat McCafferty, observed approximately 1.5 hours of instruction, then conducted a focus group with the participants.
3. Philippi then traveled to the sheet metal workers' class location and met briefly with John Nester, the site manager, and Joe Stastny, the union team teacher. Philippi then observed the class for 1.5 hours, conducted a focus group with the participants, then interviewed the instructor, Martha Ghenne.
4. On March 18, Philippi traveled to Toledo to interview instructors and observe classes. Arriving late the night of the 18th, a planned meeting with instructor Kathy Keene was unable to occur. This interview will be rescheduled via telephone.
5. The next morning, March 19, Philippi traveled to the sheet metal workers' classroom site, met briefly with the instructor, Melody Parke, observed instruction for 1.5 hours, then conducted a focus group with the participants.
6. Philippi then traveled to the electrical workers' classroom site, met briefly with Mike M.--, the union team teacher, then observed instructor, David Theiken, for 1 hour. Following the observation, Philippi moved to the union team teacher's classroom, observed instruction for approximately 30 minutes, then conducted a focus group with the participants.

Goals and Objectives:

1. During the Columbus meeting with project staff and partner representative, goals for the project were discussed. Other than changes in the master schedule for operating instruction resulting from political and logistical considerations at the various sites, the project goals appear to remain the same as those expressed by team members last August. Of concern was the recently discovered fact that the planned Akron/Canton joint site will not be possible because the unions in Akron and Canton do not work together formally as a single shop, and the area does not have a jointly-operated facility in which classes can be conducted. The project managers are looking into their options for renting classroom space in the area. The initial phase of the program in the Columbus area for electricians and sheet metal workers has been completed and reports received from instructors and staff indicated participant satisfaction with the instruction. Testimonial letters from participants at one of the Toledo sites further support the appropriateness of content and the apparent success of the program at this time in meeting participants' goals. Despite rave reviews from those union members who attended class regularly, attendance records from the electricians' classes in Columbus revealed that only five of eleven participants, or 45%, attended regularly and completed the course. Attendance records from the sheet metal workers' classes were unavailable. Demographic data was also incomplete. Of the 19 participants enrolled at the two Columbus sites, demographic data was available for only 5 attendees and posttests were administered to only five participants overall. For the TALS tests, only 4 sets of pre/posttest data are available; for the Number Operations tests, only 5 sets of pre/posttest data are available for one area of the test (Problem-Solving). The project evaluation summary report of January 25, 1994 implied that posttests were not administered in the Columbus area sheet metal workers' class because their pretest scores were much higher than those of the electricians. It is important to note that, without data for documentation, the success of the program will be limited to "feel good" comments from participants and will be unable to demonstrate concrete results. For this reason, it is recommended that instructors be reminded of the importance of collecting required data during a demonstration. If participants top out with scores on the pretest, it is suggested that an additional instrument be selected to administer as a pre/posttest measure of ability levels in order to more accurately assess progress and/or mastery of skills taught. It is also recommended that attendance policies be discussed with partnering local unions. The Toledo classes have been made mandatory for participants in journeyman programs and attendance to date is much more regular. A determination should be made, perhaps with local site options available, on how projected numbers of program completing participants will be achieved prior to the conclusion of the grant funding cycle and what can be done to encourage meeting this project goal.

2. During the Cleveland visit, the instructors were interviewed individually at each site about program goals. When asked about what she perceived to be the appropriate balance between work-related and non-work related program content, Ms. Magruder , who is instructing carpenters, responded that she feels the program should be mostly

work-related but, in actuality, is more likely to be 50%/50%. She feels that the focus of the program needs to be learner-created, e.g., that the learners contribute work examples for the materials for instruction, which she listed as one of the program goals. When asked how she will know when a participant has mastered the program objectives of instruction, she responded that she can tell by how a participant answers questions at the end of a unit of instruction and, possibly from increased scores on the TALS posttest, (although this was a bit uncertain because of consistently high scores on the TALS pretest). She emphasized that the program was not "pass/fail", but rather to "sharpen skills in order [for participants] to be more productive employees and more productive persons in society." When asked to estimate percentages of time spent in whole group, small group, and individual instruction during a typical session, Ms. Magruder was unable to respond because the first few sessions had been devoted to testing and communicating test results to participants. The class on this day was to be the first teaching session; Ms. Magruder did comment that her preference was for less whole group work. When the class was observed later that morning , Ms. Magruder spent 70% of the 1.5 hours observed time conducting whole group instruction from the front of the classroom, explaining math functions (reduction of fractions to lowest terms) at the board and calling on learners for responses, and then participants worked independently on math worksheets for the remaining 30% of the time. The relevance of examples given at the board were questioned by the carpenters during instruction because the proper fraction was expressed in 7ths; carpenters work in units that are multiples of four, *i.e.*, 4ths, 8ths, 16ths, 32nds, 64ths, etc. The relevance of the mathematical word problems were questioned by the evaluator; cutting pieces for a cabinet from a sheet of wood, *e.g.*, would not give the answer key results in real life because of the need to allow for fractions of an inch lost in sawing for each piece; this was true for a number of the problems. When asked for the source of the word problems and math worksheets, the instructor reported that they had been taken from resource books provided by OSU. The class is structured to be 1/2 academic basic skills, followed by 1/2 technical training utilizing the basic skills just taught. Pat McCafferty, the union team teacher, reported that his portion of this session would address reading house plans. When the evaluator interviewed participants in a focus group format, they indicated that they need the skills being taught on the job and in their lives, but that some of the materials in the basic skills portions of the training sessions are not as relevant to their current job tasks as they would like them to be. Participants all expressed opinions that the content of the course would be much more relevant to beginning apprentices, rather than to experienced craftsmen such as themselves. In order to make the content of the program more relevant to the participants' current on-the-job applied basic skills requirements, it is recommended that instructors be provided with a minimum amount of training in literacy task analysis and subsequently be required to conduct job-site observation/ interviews with competent craftsmen in order to better understand the applied basic skills used for performing job tasks. This should improve the relevance and credibility levels of curriculum selected by instructors for inclusion in class presentations to craftsmen participants; it should also provide instructors with enhanced skills for facilitating instructional sessions as "reciprocal learners" rather than

as traditional academic basic skills teachers, which is more in keeping with the core philosophy underwriting the grant goals.

3. During the sheet metal worker site visit in Cleveland, the evaluator interviewed the instructor, Martha Ghenne, to gather program goal statements. Ms. Ghenne feels that the program content should be 100% job-related, but stated that in this class, participants had requested that topics be 50% work applications and 50% straight basic skills brush-ups. When asked how she'd know if the goals of the program were being achieved, Ms. Ghenne responded that she knew the class members were receiving what they wanted and she could tell from their questions and work in review sessions that they were, in fact, mastering content; however, she reported that the participants originally targeted for the classes were to be experienced journeymen who had not apprenticed with the union, and, instead, the learners were upper level union apprentices mandated to attend. She reported that this has caused some wide ranges in skill abilities and needs, along with some attitudinal reluctance to participate among some class members. She and Joe, her team teacher, have solved the problem by layering multi-levels of math and problem-solving content, involving learners in demonstrations of examples, breaking learners into structured small groups, and utilizing a laptop computer to meet some class members' specific content requests and needs. When asked about how much instructional time per session was spent in whole group, small group, or individual instruction, Ms. Ghenne responded that much of what her team teacher presents is to the whole group, while most of what she does is in small groups. When the evaluator observed the class, this estimate was verified. The class was structured to have topics presented in 45-minute alternating academic basic skills and applied work basic skills segments, so that both instructors on the team could act as assistants and facilitators for each other. Records were kept in portable boxes of files and included participant pretest scores, enrollment forms, and individual portfolios with selections of class work. When the evaluator interviewed participants in a focus group format, they indicated that they, too would have preferred that the course not be mandatory at this point in their careers, but should have been made available to them early in the union apprenticeship program. Other than addressing the attendance policy, *i.e.*, mandated participation, the evaluator has no suggestions for improving instructional materials or delivery at this site. The topic flow, teacher cooperation and integration of content, ability to individualize for participants and deal with attitudinal problems might serve as a model in future teacher training sessions by videotaping classroom activities at this site.

4. Follow-up phone call to Kathy Keene, the Toledo instructor, is pending.

5. During the Toledo sheet metal visit, the evaluator observed the class taught by Melody Parke and conducted a focus group interview with participants to elicit their program goals. Ms. Parke teaches the class without a union team teacher and is solely responsible for its content and delivery, basing topic selection on requests from participants. At the beginning of the instructional session, she reiterated the topic preference of the participants for this session on "interpersonal communications." Ms.

Parke conducted the class in a lecture-style, whole group format, questioning participants directly from time to time. The content was a detailed, somewhat theoretical, description of aggressive, passive, and assertive behavioral styles, which was related to pictures of animals and personal examples; the text used for reading was a paperback book by Og Mandingo, *The Greatest Success in the World.* Densely-typed overheads, displayed throughout the presentation of information, were unreadable from the evaluator's front-row seat. Five sheet metal workers were in attendance and appeared to relate well to Ms. Parke. Ms. Parke showed a folder of letters to the evaluator that had been written by participants, documenting their comments that the course had greatly improved their self-esteem and changed their personal lives. Materials included participant ring-binder notebooks with copies of numerous academic worksheets taken from commercial texts, addressing fractions, 2-digit by 1-digit multiplication (20 pages of 20 problems per page), homonyms, using capital letters, end punctuation, commas, etc., and copies of text excerpts from published works on types of attending behaviors (*e.g.*, eye contact), learning styles, and so on. When interviewed during the focus group, participants responded to the question, *"What are the most important things you should be learning from this program?"* with: "learning about myself," "learning how to process data I take in from others," "helping you look at yourself so you know how to relate to others," and "body language." They commented that at work, they expect to use their newly learned skills to help them get along better with other union members as the Ohio and West Virginia shops are combined in the future. At home, they reported that they use their new skills to: "leave my kids notes now that say, 'Have a good day,'" "use the neuro-impression technique to read along with my son at night," and, "helped my daughter prepare for a job interview by sharing my knowledge on body language and how important it is." Given the unevenness of instructional content and wide range of levels of work-relatedness from site to site across the project, it is strongly recommended that instructors be provided with group sessions led by the project team, during which feedback and additional workplace literacy-specific training be presented. Various curricula might be shared, reviewed, critiqued, etc., by instructors in order to create a participatory atmosphere in which they assist with the development of project-wide guidelines to which they all adhere. Hopefully, this would lead to the development and practice of a more uniform set of instructional topics, materials, and learner-centered delivery techniques.

6. During the visit to the Toledo electricians' site, the evaluator observed the applied basic skills and academic basic skills classes and conducted a focus group with participants to gather program goal statements. In the basic skills class, nine electricians were participating. The instructor, Dave Theiken, questioned participants about algebra problems they had just completed on a worksheet, having them describe to the class the cognitive processes they had used to arrive at the answers and asking them to explain why they had chosen those processes. Several workers related the content of specific problems to tasks they need to perform on the job. that required them to set up equations, as they were doing now in class. The instructor elicited several examples and had the participants "translate" the language of the situation to

an algebraic equation, then had them assist him in solving it. Participants went on to offer additional examples on their own and class members helped each other set up equations from work problems, then solve them. At break time, the evaluator conducted a focus group with this class. Participants reported that they each pay $150 for this mandatory course, which is then reimbursed when they complete it. They reported that previous instruction had been on roots and affixes for two classes, using text cues to increase comprehension for one class, and using role play for improving communications for one class. Participants stated that the class was 'less that what they thought it would be' but that they felt they were 'really learning something.' The evaluator then moved on to the applied work basic skills class already in session. The classes are structured as two separate groups of 10 participants each, that move from one class to the next in sequence. The instructors repeat their segments of content for each group. In the applied skills class, Mike M.--, the union team teacher, monitored participants as they worked on electrical boards, using scratch pads to utilize the math that Dave had taught earlier in the academic class to calculate voltages used in combination circuits. Mike reported that he had given Dave, the academic basic skills instructor, a list of math topics tied to each related theory lesson he would teach and that Dave used these for his content guide. Mike stated that they had had only two weeks notice before the class began, but that he and Dave planned to work more closely together to integrate skills instruction and application for the rest of the course. When the participants were interviewed in the focus group, they indicated that the most important things for them to "learn in the program were how to make improvements on the job," and "learn the skills that support what they're doing in the field." They commented during the focus group that they were able to delegate properly at work and better able to figure loads and conduit runs. At home, one participant noted that he now could help his daughter with her math homework.

Issues and Next Steps:

Overall, the project appears to be progressing well toward meeting its goals. Two areas of concern need to be addressed at this time: 1.), the need to collect pre- and post-course test data and demographic data from ALL participants in order to document progress toward project goals; and, 2.), the need to strategize and deliver a project-wide instructor in-service session (or sessions) in order to provide necessary feedback and training in techniques to reinforce and strengthen the program's content, delivery, and overall systematic structure, which should be developed if the model is to be replicable.

Philippi will be in Columbus for DACUM training at the Center from May 16-20 and has made arrangements to meet with both Sandy Pritz and Johanna DeStefano to discuss the project. The evaluator would also like to arrange to visit other project sites as they are added to observe classes, review curriculum, and interview instructors and participants. Additionally, should an instructor in-service session be conducted, the evaluator would like to attend.

Ohio State University
Workplace Literacy Project External Evaluation
Interim Report

Activities:

Evaluators Philippi and Kirk visited project headquarters at the Center on Education and Training for Employment at The Ohio State University in Columbus on June 28, 1994 for the purposes of:

1.), observing the mid-project partners' meeting; and,
2.), attending an instructor inservice session.

1.

The mid-project partnership meeting between Ohio State University (OSU) project staff and Ohio State Building and Construction Trades Council (OSB&CTC) began with lunch at 12:00 noon. Those in attendance, representing OSU were: Sandra Pritz, Project Director; Susan Imel, Adult Education and Resources; Johanna DeStefano, Co-Principal Investigator; and Tina Lankard, Evaluation Manager.

Those in attendance representing OSB&CTC were C.J. Slanicka, Dave Williams, and Pat Day, along with training coordinators from affiliated union electrician, carpenter, and sheet metal Locals from Dayton, Cincinnati, Toledo, Columbus, Akron/Canton, and Cleveland. Three of the sites (Columbus, Cleveland, and Toledo) have already conducted 12 weeks of basic skills enhancement training for journeymen and upper level participants in the unions' skill building trade training programs. Training coordinators from these sites shared their experiences with those representatives from the three sites that will begin or continue operating basic skills enhancement programs in the upcoming fall and early winter cycles. The exchange of information appeared to be very well received by all participants because of the built-in diversity of program content at each individual site by design, based on the needs and requests of those union members who participate.

Several veteran program sites mentioned that their attendance had been very regular, but low in numbers overall. They cited short notice of program start-up as detrimental to recruitment efforts. C.J. Slanika, a liaison between OSU and OSB&CTC, indicated that, during the remainder of the project, it will be necessary for each site training coordinator to schedule classes at the site's convenience to coordinate the program with other ongoing activities. It was mentioned that, at several sites, class participants had consisted of a majority of high level union apprentices, rather than the journeymen the program was funded to target, in order to boost numbers of class participants to appropriate levels. OSU staff suggested that continuing education units might be used as an incentive for recruiting

participants among union journeymen and offered to investigate this possibility, which appeared to be well received by those union representatives present.

When asked if they would continue the program after the funded project had ended, even those union training coordinators who had spoken highly of the activities conducted at their sites, were unwilling to commit to continuing them. Two training coordinators stated that they would not know how to "sell" their members on the class content and were unsure if funds would be available to continue the classes.

At 1:30 p.m., five of the seven project instructors joined the meeting. The instructors who had already taught program classes at various sites shared their experiences with the whole group. Again, it appeared beneficial to all present to hear about the different content areas, instructional strategies, and participant reactions at each of the different sites. Tina Lankard reiterated the need for instructors and union site supervisors to support each other in data collection efforts. The evaluator also requested that the supervisors and instructors submit anecdotal reports of any instances of skill use, on the job or outside of work, mentioned by union members participating in the instructional sessions.

For the last 30 minutes of the meeting, the facilitator directed the union representatives and the instructors to mingle, verbally share additional experiences, and question, then debrief with the entire group. Most of the union representatives left the meeting one by one during this time. One union representative commented that "the group had understood the meeting end time to be 2:30," rather than the actual 3:00 o'clock end time stated on the meeting announcement they had received. A very short debriefing concluded the meeting, with only one union representative still present at the time.

Suggestions:

- The diversity of experiences related during the meeting was rich in instructional variety and techniques; however, it could cause confusion about stated goals and objectives among newly participating sites scheduled for the next two cycles. It is recommended, therefore, that the OSU project staff review program goals and operating procedures with each new site in order to avoid potential misunderstandings or oversights. Suggestions might also be given to the union Locals about recruiting techniques and timetables for giving participants adequate lead-time to sign up for classes. If time permits, OSU staff might design some "generic" flyer templates and local union newsletter releases, along with application forms, that could be given to each site for immediate use by merely inserting their own local identification/ location/ scheduling information into the template and reproducing it.

- Based on the behavior of the union representatives at the meeting, *i.e.*, leaving early and vying for control of class scheduling, it is the opinion of the external evaluators that the commitment level of the trade organizations is nominal, yet viewed by its leaders as a valuable bargaining chip with locals. For these reasons, the relationship with the OSB&CTC needs to be nurtured by OSU staff if the project is to be as successful as its potential plan (as outlined in the proposal) indicates it should be. Structuring activities by providing additional "assistance" such as the recruitment publication templates, whenever possible, is one way for OSU to facilitate project operations and enhance the likelihood of accomplishing project goals-- namely, meeting numbers-to-be-served quotas and institutionalizing the program.

- The issue of paired sets of data, *i.e.*, pre/post test scores for all participants, needs continued attention by the OSU project staff to ensure that required information is collected. Tina Lankard's decision to send structured "data collection folders" to each site is a good one. Any forms that can be developed to facilitate eliciting information from instructors and site supervisors also would be advantageous to these efforts. It is recommended that the OSU project staff be diligent in reminding the instructors and site supervisors on a regular basis that this is, in fact, a demonstration project, and that data must be collected to substantiate any progress toward goals and anticipated outcomes.

- Additionally, it is recommended that all of the various teaching activities, rated as "highly-effective" by the instructors who utilized them at different sites, be recorded for possible selection and distribution to instructors at sites in the upcoming cycles. An edited, carefully screened version of these same activities also might be prepared for potential dissemination as a project publication product at the conclusion of the demonstration. (Please note: the external evaluator has requested copies of "best lessons and why" from each instructor and can provide these to the OSU team for distribution and/or dissemination.)

2.

The instructor inservice session convened at 3:00 p.m., following the departure of the union representatives. It began with a 40 minute hands-on demonstration of a computer authoring system for the instructors to consider for use as a tool in the field. (One union Local representative stayed for this portion of the inservice session.) The instructors operated computers to each explore some sample lessons, then developed a few of their own instructional screens and viewed them. Their reactions and comments indicated that they had interest in obtaining the system for use with the project.

The group then met with Johanna DeStefano for a two-hour discussion of the communications strand of workplace literacy. Dr. DeStefano distributed hand outs about workplace literacy basic skills applications, curriculum planning, collaborative small groups, sentence combining exercises, and a lesson plan format.

In addition, she provided a long list of resources for instructors to consult about creating lessons on workplace applications of basic skills. (The external evaluators request that copies of the handouts be forwarded to them.) The instructors appeared appreciative of the information they received, but their comments and questions indicated that they are still somewhat uncertain about what they need to do to construct effective lessons. The meeting was rather hastily adjourned at 5:30 to accommodate travel requirements of participants.

Suggestion:

- The instructors appeared to enjoy the opportunity to share experiences and instructional ideas with each other, but the duration time of the inservice session seemed to be too brief to address more than an overview of sources for additional information. Based on the evidence of information revealed in instructor comments, it appears that the instructors would welcome more inservice time and more specific instruction in the creation of functionally contextual applied workplace basic skills curriculum. It is recommended that additional inservice sessions be held on a regular basis

- Although all of the instructors have outstanding credentials, it is important to remember that all talented instructors are not necessarily equally talented in the area of curriculum development. This project is extremely demanding upon the instructors as they must create many of their own teaching materials and coordinate their lessons with training site trade context, as well as meet individual participant requests. For this reason, there appears to be a less than desirable level of comfort among the instructors. It is recommended that a structured, hands-on training session in curriculum development be offered as one of the inservice sessions. Modeling of curriculum development skills and hands-on practice could raise instructor comfort levels and more clearly define project performance expectations. It also could serve as a means for setting parameters for acceptable applied workplace basic skills teaching topics-- and as a means for sharing and demonstrating how to enhance teamwork relationships with union Local site supervisors for coordinating technical and educational lesson objectives. Prior to the inservice session, an instructional topic of an applied basic skill might be chosen from one of the sites and workplace materials and information about the specific work task collected. A lesson could then be planned and scripted out from these resources as a modeled exercise for the instructors. If inservice were to be held for an entire day, practice time could follow, during which instructors worked in small groups to create additional lessons. The products from such an inservice could then be shared across sites, as applicable to self-identified individual participant needs. (NOTE: If the previewed software authoring system is licensed, a training session for using it might be combined with such a workshop agenda in a one-day inservice session format.)

Next Steps:

If the software authoring system is licensed for use, a training session for all instructors should be conducted prior to the fall start-up of the next cycle of instruction. Schedules for instruction at the various site locations should be finalized as soon as possible. The evaluator would like to have copies of these as they become available so that planning for visits to the remaining three sites can occur.

Ohio State University
Interim Evaluation Report
Site Visit #4

Activities:

The purpose for the site visits was to obtain goal statements from participants and instructors, to gather samples of curriculum, and to observe the process of instruction. In addition, the evaluator wished to meet with the project directors and representative for the partnering unions to receive up-dated goal statements and information about the status of current and future project activities and timelines. Evaluators Philippi and Kirk visited Dayton/Cincinnati on February 7 and Cleveland on February 8, 1995.

1. Philippi and Kirk met instructor Sandra Denny at her home in Chillicothe, OH at 4:00 p.m. on February 7, then followed her by car to the scheduled 6:00 p.m. millwright class at the carpenters' local apprenticeship training center in Poast Town, OH, in the vicinity of Dayton/Cincinnati. Due to the death of his father, the union trainer did not come to open the building, so class was canceled after waiting 1/2 hour outside. Participants and the instructor accommodated the evaluators by reconvening in a roadhouse nearby for approximately 1 hour to provide information for the structured interview data collection session. At 8:00 p.m., the evaluators and instructor departed and returned to Chillicothe.

2. Philippi and Kirk traveled from Chillicothe to Cleveland on February 8 and arrived at the Local 38 Electrical Workers' apprenticeship training center at 5:15 p.m.. Class start time was delayed approximately one hour due to ice/snow weather conditions and to allow time for participants to eat the supper provided for them by the local. Nineteen participants attended. The evaluators observed the class for 2.25 hours, until 8:00 p.m. and met briefly with instructor Tina Barrett, then departed for the return drive to Charleston, WV that night.

Goals and Objectives:

1. Although implementation of instruction could not be observed because of the inability to obtain entrance to the training facility, the instructor provided information about the typical class attendance (7-10 participants) and content (algebra). She showed us the handouts she would use for text during the next two classes and gave an overview of the math topics she had taught (fractions, decimals, etc.) and the assessments she had administered. The quality of materials duplication appeared excellent and the content appeared relevant to the instructional needs the participating millwrights have expressed and to their assessed operational levels. Individual participant folders and records were unavailable for review, due to the circumstances. Nine participants, who were sitting in their individual cars in the parking lot when we arrived, were most helpful in developing a solution to our situation, suggesting caravanning to a nearby local establishment as an alternative meeting place for conducting evaluation activities. They also commented on

their willingness to have their instructional session there following our data collection group interview, but the dim lighting, booth seating, and potential disruption of local patrons' activities did not lend themselves to this activity. Upon arrival, several participants obtained permission from the bar manager to conduct our meeting and offered to buy the instructor and evaluator soft drinks. Despite an atmosphere of billiards, video games, jukebox music, and other big-screen sports bar activities in progress during our gathering, the participants eagerly responded to questions as a group. Several approached us after the structured interview to offer personal comments about their instructional experiences with the program, including one dictated, positive statement that the respondent requested to have incorporated into our final report to "the guys in Washington [DC] and at Ohio State." Participants volunteered specific examples of job contexts in which they will use the math skills they have learned from this program. Overall, comments were extremely positive and all participants rated the instructor and class high. Weather conditions (snow) continued to deteriorate during our visit; consequently, the evaluators left an Instructor Structured Interview evaluation form with Sandra to fill out and return at the March 13 meeting. She agreed to do so and to provide the evaluators with a copy of her curriculum at that time. Both the evaluators were positively impressed by the high levels of professionalism and flexibility exhibited by the instructor throughout this unpredictable, adventure-laden evening.

2. The class in Cleveland was greeted by the training center director because it was meeting for the first time. Following welcoming remarks and a brief history of the program, the director introduced both instructors and the evaluators to the group of nineteen participants and an observing training center instructor, who participated in the class. The director mentioned that, despite a late-in-the-demonstration start-up at their site, they have discovered great enthusiasm among the electricians for the classes to be offered. Local members have already signed up for the next five classes (20 slots per class) as soon as they can be scheduled. The instructors began by asking the participants to pair off, question each other about information relevant to this course, then introduce each other to the group. Most were electricians who worked as foremen in area companies, with an average of 30-plus years of experience in their trade. The OSU instructor, Tina Barrett, overviewed the course purpose, program philosophy, and session objectives, then co-led a team-building, supervisory skill development communication exercise. The participants completed half the exercise in pairs in the classroom, then moved to the electrical lab to work in teams to construct a project. Next they returned to the classroom area to debrief in the whole group. Participants appeared interested and cooperative, adding many insightful comments to group discussions and activities and becoming quickly and thoroughly engaged in each segment of instruction. There appeared to be a mild "first-night" undercurrent of tension between the two instructors as they co-directed the class, but it is assumed that this will quickly dissipate as they work together on a regular basis. Both instructors shared the session plan with the evaluators to provide a summary of what would not be seen in the last hour of instruction. The evaluators both felt that the activities were creative, interesting, thoughtfully planned, and well-delivered to meet their stated objectives. The instructors worked well as a team, supporting each

other in most activities observed. A copy of the participants' notebook was provided, containing the first session's materials. Tina offered to bring additional course materials and lesson plans that are developed to the March 13 meeting for review. Because this was the first meeting of the group, and because the class activities were running a bit longer than anticipated, the evaluators and instructors agreed that it was better to wait for several more weeks until administering the Instructor Structured Interview and Participant Focus Group Structured Interview evaluation instruments. Tina offered to administer the interview to the participants late in March. The instructors will be contacted by telephone to complete their interviews with the evaluators within the next month, as well. At 8:00 p.m., the evaluators departed so that assessment instruments could be administered by the instructors.

Issues and Next Steps:

Based on information gathered during site visit to Poast Town location, there appeared to be no input into instruction by the union trainer, other than coming to building to unlock the door two nights per week. Although the class is over and participants reported being very satisfied with the instruction they received, this varies greatly from the published demonstration design. It is recommended that OSU staff think of ways to utilize research data to document for union partners the fact that impact on performance (due to higher levels of positive transfer of learning to performance) is greater when skills are taught *in context*--or in this case according to your proposal design, *interwoven with contextual session components* to provide immediate application and practice.

Philippi will meet with OSU staff and grant partners at meeting in Columbus at CETE on March 13 from 10:00 a.m. to 3:00 p.m. During the meeting it would be good to set aside some time in the agenda to discuss outstanding data requests and to determine those final evaluation report emphases for all partners that would be most beneficial to promoting any program expansion or replication efforts that may be planned for the future.

Appendix D:

Sample Literacy Task Analyses

(DACUM DELTAs)

for

Carpentry

Sheet Metal

Electrical

ELECTRICIAN TASKS

A. Fundamental Concepts of Electricity: Safety

A-1 Maintain safe health work environment	A-2 Maintain tools and equipment	A-3 Recognize a safe and healthy environment	A-4 Administer CPR	A-5 Administer basic first aid
• Order safety equipment: call shop; order from supply shop (reading catalog, reading forms) • List required safety equipment • Document safety checks • Conduct job-site safety meetings		• Read job site safety standards • Read specific job policies • Read the company's safety policy • Identify relevant portion of OSHA standards by reading or visual aids • Question safety director about job standards and policies • View visual aids	• Obtain CPR certification (read, write, oral skills) • Telephone for help, communicate with victim • Visually inspect to comply with standards • Read specs for equipment/tools • Complete maintenance records	• Read information relevant to injury: MSDS, labels • Identify problem through observation and communication • Obtain first aid certification (read, write, oral skills)

B. Fundamental Concepts of Electricity: Electrical Principles

B-1 Analyze and measure values in direct current (DC)	B-2 Analyze and measure values in alternating current
• Calculate formulas for circuit under analysis	• Read blue prints and schematics, instrument instructions • Measure electrical variable • Record measured values • Read system manual

C. Fundamental Concepts: Single-Phase and Three-Phase Systems

C-1 Install power distribution systems	C-2 Maintain power distribution systems	C-3 Install branch circuit wiring		C-4 Maintain branch circuit wiring
• Read technical manual • Discuss installation with foreman and co-workers • Measure physical dimensions • Read blueprints and specs • Record equipment data	• Visually inspect equipment • Measure equipment data • Read measurements	• Read technical manuals • Measure physical dimensions • Discuss installation with foreman and co-workers • Read specs and blueprints • Read equipment data • Read measurements	• Measure equipment data • Visually inspect equipment	

D. Planning and Job Layout

D-1 Read and interpret blueprints and specifications		D-2 Implement the National Electrical Code (NEC)	D-3 Determine equipment needed	D-4 Determine materials needed	D-5 Determine labor needed
• Verify electrical device locations with customers • Transfer scaled measurements and specs from blueprints to job site • Develop alternate solutions • Coordinate with other trades • Document as-built installation on specs and blueprint	• Update blueprints and specs • List equipment, materials, and labor needed per job site • Coordinate equipment, materials, and labor needed per job site (oral communication and requests)	• Read tables • Discuss electrical installation with inspector • Read for working knowledge of the current code book • Read specific articles in the current code book that pertain to the installation	• Schedule equipment arrival per job site need • Schedule materials per job site need	• Calculate materials needed	• Assign duties to workers on job site (orally or written) • Complete payroll and labor reports • Schedule labor per job site need

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E. Residential Applications: Residential Installations	E-1 Install and rough in wiring	E-2 Analyze and install distribution systems	E-3 Finish wiring		
	· Apply all basic skills per NEC code (also see PLAN X Layout duty)				
F. Maintenance of Systems: Residential	F-1 Trace circuits to locate problems	F-1a Use test equipment	F-1b Analyze blueprints to identify circuit function	F-2 Trouble shoot	F-3 Repair
	· Apply all basic skills per NEC code (also see Plan X Layout duty)				
G. Residential Applications: Specialized Systems	G-1 Install low-voltage systems	G-2 Install security, fire alarm, and energy-management systems	G-3 Service security, fire alarm, and energy-management systems		
	· Read manuals and codes for Lan's system and Smart House				
H. Industrial Installations	H-1 Rough in conduit system		H-2 Install branch systems	H-3 Maintain branch systems	
	· See Industrial Installations for all basic skills · Use basic math skills, %, fractions, ratio, metric and standard measurements, algebra	· Calculate angles, bends, degrees, and radius through trig functions, geometry (plane and solid), Pythagorean theory, square roots, analog	· Determine specific materials for location · Determine pulling technique required · Communicate with foreman · Read color codes · Read blueprints and specs · Determine number, size, and color code of wires	· Check that observations match with blueprint and specs · Read blueprints and specs	

I. Specialized Industrial Installations	**I-1 Install motors and motor control**	**I-2 Install programmable controls**				
	· Read schematic drawings · Read blueprints and specs · Calculate over-current protection (heaters) · Calculate control wires and piping · Design and redesign control circuit for mode of operation · Use calculator for all needed functions					
J. Equipment Installation	**J-1 Prepare for equipment installation**	**J-2 Install equipment**				
	· Read manual to rig equipment · Design map and method for transport of equipment to permanent location (geographical plan and lift) · Calculate weight and design method for transport of equipment	· Read manuals and specs (torque settings) · Identify and implement fastening technique · Coordinate with other trades (communication)				
K. Commercial Installations	**K-1 Rough in conduit system**	**K-2 Install branch systems**	**K-3 Maintain branch systems**			
	· Design and redesign control circuit for mode of operation · Calculate control wires and piping · Read schematic drawings · Read blueprints and specs					
L. Fundamental Concepts: Single-Phase and Three-Phase Systems	**L-1 Install low-voltage systems**	**L-2 Install security & fire alarm systems**	**L-3 Install energy-management system**	**L-4 Install Power Factor Correction Equipment**	**L-5 Install Fiber Optics**	**L-6 Install Instrumentation Systems**
		· Acquire license for fire alarm systems · Read and interpret fire alarm codes (include NEC code)		· Calculate capacitor needed to correct power factor	· Calculate pulling torques	

L. Fundamental Concepts: Single-Phase and Three-Phase Systems (cont.)	L-7 Maintain Specialized Systems	L-7 (Future) Install Power Harmonics Correction Equipment

M. Planning and Job Layout	M-1 Trace circuits to locate problems	M-1a Analyze schematics to identify circuit function	M-1b Use test equipment and tools	M-2 Troubleshoot problems	M-3 Make repairs as needed
	• Read schematics				

CARPENTER

A. Basic Carpentry Procedures

A-1 Acquire tools and tool kit	A-2 Use personal safety equipment according to OSHA standards	A-3 Demonstrate use of safety and fire equipment	A-4 Demonstrate identification, handling, use, & disposal of hazardous materials	A-5 Use, handle, and store all tools, materials, and equipment	A-6 Use construction drawings
• Read manufacturers' specs	• Interact with coworkers about safety • Attend contractors' job site safety presentations		• Read MSDS sheets (materials safety data sheets)	• Interpret warning signs	

A-7 Use instruments and tools for layout work	A-8 Read blueprints	A-9 Perform rigging and signaling operations
• Use standard function calculator	• Read change orders • Visualize finished product	• Read manufacturers' stamps on materials • Communicate with trainers and clients about procedures

B. Layout Work

B Basic skills for all tasks in group B		B-1 Establish corners and elevations; read blueprints	B-2 Determine wall, ceilings, and floor locations	B-3 Determine location of footers and all below grade structures	B-4 Determine location of columns and all above grade structures
• Record measurements • Discuss changes with supervisors • Read scales • Add and subtract decimals • Convert decimals to fractions • Add and subtract fractions • Record field notes • Add and subtract angular measures	• Compute grades using percentages • Transfer readings to stakes • Signal partner (distance) • Identify job-site problems • Back check operations by measurement, computation, and triangulation, Pythagorean Theorem, trigonometric calculation of angles			• Verify field dimensions • Alert supervisor to problems	

B-5 Determine site work requirements	B-6 Lay out components for construction
• Read specifications • Read testing procedures	

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C. Concrete Form Work

C Basic skills for all tasks in group C	C-1 Lay out concrete components	C-2 Identify hardware and form materials	C-3 Estimate materials	C-4 Construct job-build forms	C-5 Construct patented forms
· Calculate locations using lasers · Plan for disassembly · Read blueprints and shop drawings · Read testing procedures · Read blueprints · Read specs			· Compute circumferences · Calculate perimeter, area, and volume · Convert cubic measurements		· Read manufacturers' manuals
C-6 Construct all-weather wood foundation	**C-7 Construct flatwork**	**C-8 Construct stairs**	**C-9 Construct walls**	**C-10 Construct footers**	**C-11 Construct decks**
C-12 Construct columns	**C-13 Construct beams**	**C-14 Tie in columns, beams, and decks**			

D. Framing

D-1 Layout framing components	D-2 Erect girders, beams, and columns	D-3 Install floor joists, bridging, and subflooring	D-4 Install sills and sill sealer	D-5 Build and erect walls	D-6 Install ceiling joists and bridging
· Compute stairwell openings	· Sequence operational steps			· Read door and window schedules	

D. Framing (cont.)	D-7 Install soffits and backing	D-8 Estimate materials				
		• Transfer measurements to mark materials (make legible) • Read blueprints				
E. Stairs	E-1 Layout stair components	E-2 Design stairway risers, treads, and head clearances	E-3 Fabricate closed stairs	E-4 Fabricate open stairs	E-5 Fabricate combination stairs	E-6 Fabricate exterior stairs
						• Calculate stair angles, lengths, and elevations by using algebra and geometry
F. Roof Framing	F-1 Locate roof framing components	F-2 Lay out common rafters	F-3 Lay out rafters for intersecting roofs	F-4 Lay out rafters for hip and valley roofs	F-5 Install roof trusses	F-6 Install roof sheathing
		• Read framing square scales • Compute diagonals for right triangles	• Read framing square scales • Compute diagonals for right triangles	• Read framing square scales • Compute diagonals for right triangles		• Calculate ratios and proportions • Calculate roof angles, lengths, and elevations by using algebra and geometry (similar triangles)
G. Exterior Finish	G-1 Lay out roofing	G-2 Install wall finish	G-3 Install dripedge and flashing	G-4 Install composition shingles and caps	G-5 Install roll roofing	G-6 Install wood shingles and caps
	• Read manufacturers' instructions	• Read manufacturers' instructions	• Read manufacturers' instructions	• Calculate suitable exposure for shingles • Read manufacturers' instructions	• Read manufacturers' instructions	• Read manufacturers' instructions

G. Exterior Finish (cont.)	G-7 Install exterior doors, windows, and hardware	G-8 Install gutters and downspouts	G-9 Install exterior trim			
	• Read manufacturers' instructions	• Calculate suitable capacity for gutters and downspouts • Read manufacturers' instructions	• Read manufacturers' instructions			
H. Interior Systems	H-1 Install suspended ceilings	H-2 Install metal studs and drywall	H-3 Install curtain walls	H-4 Install lathing systems	H-5 Install door frames	H-6 Install demountable partitions
	• Ensure that ceiling is attached to appropriate location (placement, weight, etc.) • Become certified in using powder-actuated tools (Hilti, Ram Set) • Install systems using lasers • Read blueprints	• Become certified in using powder-actuated tools (Hilti, Ram Set) • Install systems using lasers • Read blueprints	• Become certified in using powder-actuated tools (Hilti, Ram Set) • Install systems using lasers • Read blueprints	• Become certified in using powder-actuated tools (Hilti, Ram Set) • Install systems using lasers • Read blueprints	• Become certified in using powder-actuated tools (Hilti, Ram Set) • Install systems using lasers • Read blueprints	• Become certified in using powder-actuated tools (Hilti, Ram Set) • Install systems using lasers • Read blueprints
I. Interior Fir ish	I Basic skills for all tasks in group I	I-1 Install wall paneling	I-2 Install doors	I-3 Install cabinets and casework	I-4 Install standing and running trim	I-5 Install door and window hardware
	I-6 Install stairs and stair components	I-7 Fabricate countertops				

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J. Flooring

J Basic skills for all tasks in group J	J-1 Layout floor components	J-2 Install access floors	J-3 Install exterior and interior carpet	J-4 Install ceramic tiles	J-5 Install composition tile floors

J-6 Install terrazzo floors	J-7 Install wood floors	J-8 Install resilient sheet goods	J-9 Install floor and base trims (vinyl, rubber, and metal)

K. Cabinetry

K Basic skills for all tasks in group K	K-1 Install display and casework	K-2 Cut stiles and rails	K-3 Apply laminates and veneers	K-4 Cut leg and rail components	K-5 Set up stationary machinery and portable equipment

K-6 Fabricate jigs, templates, and fixtures	K-7 Establish rod layout and delta system	K-8 Read cabinetry blueprints	K-9 Fabricate drawer and roll-out assemblage	K-10 Assemble cabinet joints	K-11 Construct fine furniture

K. Cabinetry (cont.)	K-12 Apply gluing, assembling, and clamping techniques					
L. Energy-Efficient Construction	L Basic skills for all tasks in group L	L-1 Construct double exterior walls, foundations, and superinsulated floor framing	L-2 Install windows and superinsulated doors	L-3 Superinsulated structures	L-4 Construct underground structure	L-5 Use Arkansas construction method of insulation
	L-6 Install passive solar features	L-7 Caulk exterior finishes	L-8 Ventilate attic and crawl spaces	L-9 Install thermal insulation and vapor barrier		
M. Special Carpentry Applications	M Basic skills for all tasks in group M	M-1 Install garage doors and openers	M-2 Install porches and decks	M-3 Install window and door replacements	M-4 Perform welding and cutting operations	M-5 Install job-site safety barriers

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M. Special Carpentry Applications (cont.)	M-6 Erect scaffolding	M-7 Prepare site for asbestos abatement	M-8 Work in hazardous materials environments	M-9 Construct weather protective enclosures		
	· Calculate loads using proportions and ratios					
N. Pile Driving	N Basic skills for all tasks in group N	N-1 Install various piling (sheet/pipe/wood/beam)	N-2 Perform cutting and welding	N-3 Perform signaling and rigging		
O. Millwrighting	O Basic skills for all tasks in group O	O-1 Read blueprints	O-2 Cut/weld	O-3 Perform alignment and installation	O-4 Perform rigging and signaling operations	O-5 Use optical instruments
	O-6 Perform conveyor alignment and installation					

SHEET METAL

A. Supervisory Tasks

A-1 Estimate jobs

- Use computers: spread sheets, databases, word processing
- Read (materials costs) in vendors submittals and proposals
- Read references to previous jobs
- Read blueprints and take-offs
- Resolve problems with overlooked requirements
- Calculate costs by square foot and weight, labor and time, equipment and tools (i.e., add and multiply and percentage using calculator and computer)

A-2 Order equipment and material

- Read Sweets catalog, SMACNA manual, local building codes, material standards, weight calculations, load stresses
- Communicate with suppliers, manufacturers, architects, and engineers
- Write letters, make phone calls

A-3 Provide liaison and coordination of jobs

- Communicate with manufacturers, other trades, and field site
- Time order so that staged/sequenced for on-time delivery
- Resolve communication matters between field and shop

A-4 Make judgment call in field installation

- Use diplomatic procedures to insure job is done according to specs

A-5 Administer safety and hazard communication

- Conduct weekly safety (tool box) meetings
- Use teaching skills (e.g., lesson plans)

A-6 Adhere to OSHA regulations, local requirement code, MSDS sheets, local, state and federal requirements

B. Sheet Metal Drafting and Detailing

B-1 Interpret blueprint and specifications

- Convert metric system to English and vice versa
- Read submitted paperwork, supply catalogs, Ryerson chart
- Read terms and definitions
- Resolve conflicts between mechanical and structural plans

B-2 Develop shop drawings

- Convert metric system to English and vice versa
- Read and understand terms and definitions
- Resolve conflicts between mechanical and structural plans
- Use trig to lay out angles
- Convert feet and inches to decimals
- Write and print legibly
- Read mechanical symbols
- Use algebra, trig, basic and advanced math to develop shop drawings
- Use fractions to figure size of ducts
- Add and subtract measurements to get locations on drawing

B-3 Detail shop tickets

- Convert metric system to English and vice versa
- Read terms and definitions
- Develop a materials cut list

B-4 Measure to verify field conditions

- Convert metric system to English and vice versa
- Read terms and definitions
- Add and subtract in feet and inches
- Translate from scale to actual measurements
- Interpret elevations

B-5 Interpret field dimensions

- Convert metric system to English and vice versa
- Read terms and definitions

B-6 Perform CAD operations

- Convert metric system to English and vice versa
- Read terms and definitions

B-7 Adhere to OSHA regulations, local requirement code, MSDS sheets, local, state and federal requirements

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C. Shop Layout including Industrial Sheet Metal	C-1 Operate CAD/CAM systems	C-2 Layout round duct and fittings		C-3 Lay out rectangular duct and fittings		C-4 Adhere to OSHA regulations, local requirement code, MSDS sheets, local, state and federal requirements
	· Use computer skills · Read labels · Read and follow instruction manual, shop tickets to key in program, keyboard	· Use basic trig, plane and solid geometry, algebra for formulas, for cut sizes, volumes, areas, circumferences (know when to apply) · Read layout reference books (REED, Sheet Metal Workers Pocket Guide, Kamberlin, Sheet Metal Tool Box Manual)	· Recognize and apply symbols · Read shop prints and align to fittings · Incorporate tolerances and allowances · Calculate using calculators	· Use basic trig, plane and solid geometry, algebra for formulas, for cut sizes, volumes, areas, circumferences (know when to apply) · Read layout reference books (REED, Sheet Metal Workers Pocket Guide, Kamberlin, Sheet Metal Tool Box Manual)	· Recognize and apply symbols · Incorporate tolerances and allowances · Calculate using calculators	
D. Shop Fabrication and Assembly including Industrial Sheet Metal	D-1 Operate shop equipment	D-2 Fabricate round duct and fittings	D-3 Fabricate rectangular duct and fittings	D-4 Adhere to OSHA regulations, local requirement code, MSDS sheets, local, state and federal requirements		
	· Figure material cut list (fractions, decimals, basic equations, circumferences) · Use trig for bend allowance · Read operating manual for all shop equipment	· Correlate location with shop drawing · Recognize and apply symbols · Use Pythagorean Theory for cut sizes and tapered pieces	· Correlate location with shop drawing · Recognize and apply symbols · Use Pythagorean Theory for cut sizes and tapered pieces			
E. Field Installation including Industrial Sheet Metal	E-1 Operate field equipment	E-2 Coordinate installation with other trades	E-3 Install according to blueprints	E-4 Erect scaffolds and ladders	E-5 Perform rigging and lifting for installation	E-6 Adhere to OSHA regulations, local requirement code, MSDS sheets, local, state and federal requirements
		· Communicate with other workers (hand signals, hand held radios, crane signals) · Resolve conflict between blueprints/specs and architects/engineers	· Calculate dimensions for location · Use architect scale (feet, inches, fractions, decimals)	· Calculate ladder angle, scaffold height, safety standards	· Calculate weights, capacities, distance · Communicate with other workers (hand signals, hand held radios, crane signals)	
F. Welding	F-1 Fabricate according to welding procedures	F-2 Operate heli-arc T.I.G. welding machine	F-3 Operate oxyacetylene welding to weld, cut, and braze	F-4 Operate an electric arc welder	F-5 Operate M.I.G. welding equipment	F-6 Operate plasma and laser cutting equipment
	· Read welding equipment/duty cycle chart · Read welding symbols, blueprints, certification standards · Read operating manual, welding, rod specifications	· Read flow chart for T.I.G. welding procedure · Calculate current versus rod	· Calculate gas pressures, thickness, burning type and tip size (from chart)	· Calculate current versus rod	· Calculate current versus rod	

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F. Welding (cont.)	F-7 Adhere to OSHA regulations, local requirement code, MSDS sheets, local, state and federal requirements					
G. HVAC Systems (Heat, Ventilating and Air Condition-ing)	G-1 Install mechanical equipment	G-2 Service and (set up) equipment			G-3 Test, adjust, and balance equipment	
	• Read submittals, operational manuals, equipment manuals	• Take instrument readings • Make calculations (decimals): Ohm's Law, heat load calculations, temperature pressure relationships • Customer relations and communications • Locate information in Modern Refrigeration, by Wilcox	• Read and complete manufacturers' checklist, warranties, and service contracts • Verify electrical and control drawings • Read charts, fan curves, pump curves, temperature charts, temperature pressure relationships	• Use computer skills (keyboard, DOS, energy management programs, DDC controls, other building automation systems) • Problem solve customer complaints	• Read and interpret psychrometric chart • Read submittals, operational manuals, equipment manuals • Complete forms (detailed) for all equipment, mark measurements, print legibly, and organize paper work • Problem solve customer complaints	• Calculate volumes, areas, roots, powers, cubes/cube functions, equations, fan laws, horsepower, instrument readings • Communicate (oral) between installers and engineers • Verify electrical and control drawings
	G-3 (continued)	G-4 Evaluate efficiency of system	G-5 Adhere to OSHA regulations, local requirement code, MSDS sheets, local, state and federal requirements			
	• Use computer skills (keyboard, DOS, energy management programs, DDC controls, other building automation systems) • Read charts, fan curves, pump curves, temperature charts, temperature pressure relationships	• Calculate heat load and heat gain (D-Manual and J-Manual) • Use computer skills (keyboard, DOS, energy management programs, DDC controls, other building automation systems) • Verify electrical and control drawings				
H. Archi-tectural Sheet Metal	H-1 Lay out architectural components		H-2 Fabricate architectural products	H-3 Install architectural components according to prints	H-4 Restore and repair architectural items	H-5 Install siding and decking
	• Use basic trig, plane and solid geometry, algebra for formulas, for cut sizes, volumes, areas, circumferences (know when to apply) • Read layout reference books (REED, Sheet Metal Workers Pocket Guide, Kamberlin Sheet Metal Tool Box Manual)	• Recognize and apply symbols • Read shop prints and align to fittings • Incorporate tolerances and allowances • Calculate using calculators	• Read charts: tolerance, expansion, contraction • Refer to Sweets Book • Refer to SMACNA Architectural Sheet Metal Manual and Sweets	• Read manufacturer's installation specs	• Refer to Revere Copper Manual	

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H. Architectural Sheet Metal (cont.)	**H-6 Perform rigging and lifting for installation**	**H-7 Adhere to OSHA regulations, local requirement code, MSDS sheets, local, state and federal requirements**		
	• Calculate weights, capacities, distance • Communicate with other workers (hand signals, hand held radios, crane signals)			
I. Food Service	**I-1 Perform specialty fabrications**	**I-2 Perform specialty welding and finishing**	**I-3 Perform detailed and precise installations**	**I-4 Adhere to OSHA regulations, local requirement code, MSDS sheets, local, state and federal requirements**
	• Read design specs • Duplicate C-2, C-3, D-2, & D-3?	• Read manufacturer's specification for stainless steel buffing and polishing (3M) • Calculate for expansion and stress • Duplicate F-1 and F-2		

Appendix E:

Sample Curricula/ Instructional Materials

Collected from Sites

38 Extra Practice & Mixed Review

Name Key

Class _____

(Use after completing Lesson 4.7, pp. 98-99)

Date _____ Score _____

▶ Extra Practice (Lesson 4.7)

Use the table at the right to answer the following questions.

Year	Faron's Salary	Daniel's Salary
1980	$13,000	$11,500
1981	14,000	12,500
1982	15,500	13,000
1983	16,500	14,000
1984	18,000	15,500
1985	20,000	17,000
1986	22,500	19,500
1987	24,500	21,500
1988	26,500	22,500
1989	28,000	23,500

1. What information is presented in the table? How many years are shown?

_____

2. In what year did Faron earn $16,500?

_____

3. What was the increase in Faron's salary from 1980 to 1982? In Daniel's?

_____

4. What were the increases in Faron's salary each year, from 1980 to 1985?

_____

5. What is Daniel's salary in 1989? What is Faron's salary? Who earns more money?

_____

6. What was the increase in Daniel's salary from 1983 to 1986? From 1987 to 1989?

_____

7. How much money did Faron earn from 1980 through 1989? How much did Daniel earn?

_____

8. How much more is Daniel making in 1989 than in 1984?

_____

9. How much more than Daniel did Faron earn from 1980 through 1989?

_____

▶ Mixed Review (Lessons 3.5, 3.7)

Divide. (Lesson 3.5)

10. $38\overline{)1938}$

11. $32\overline{)2244}$

12. $33\overline{)37,037}$

13. $25\overline{)53,545}$

Use *Read, Plan, Do,* and *Check* to solve. (Lesson 3.7)

14. Paul had some hats. He bought four more. He gave Ben two. Greg gave him one. He now has nine hats. How many did he start with?

_____

15. Lauren runs around the track in 60 seconds. It takes Justin 40 seconds. If they start together, when will their paths cross again?

_____

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39 Extra Practice & Mixed Review

Name Key

Class

(Use after completing Lesson 5.2, pp. 112-113)

Date Score

▶ Extra Practice (Lesson 5.2)

Find 3 fractions equivalent to each fraction.

1. $\frac{1}{3}$ 2. $\frac{1}{5}$ 3. $\frac{7}{8}$ 4. $\frac{5}{6}$ 5. $\frac{7}{5}$ 6. $\frac{11}{8}$

7. $\frac{3}{2}$ 8. $\frac{3}{8}$ 9. $\frac{5}{3}$ 10. $\frac{7}{9}$ 11. $\frac{9}{8}$ 12. $\frac{4}{3}$

Use division to find a fraction equivalent to each fraction.

13. $\frac{4}{12}$ 14. $\frac{10}{12}$ 15. $\frac{18}{20}$ 16. $\frac{15}{18}$ 17. $\frac{21}{24}$ 18. $\frac{30}{50}$

19. $\frac{14}{16}$ 20. $\frac{20}{24}$ 21. $\frac{10}{16}$ 22. $\frac{30}{20}$ 23. $\frac{12}{10}$ 24. $\frac{10}{8}$

Solve.

25. There are 12 inches in a foot. Using equivalent fractions, find how many inches are in $\frac{3}{4}$ foot.

26. A parking lot is divided into 150 stalls. Using equivalent fractions, find how many stalls are in $\frac{3}{5}$ of the parking lot.

▶ Mixed Review (Lessons 2.3, 3.5, 4.6)

Multiply mentally. (Lesson 2.3)

27. 8×100 28. 12×1000 29. 30×15 30. 60×300

31. $83 \times 10{,}000$ 32. 53×2000 33. 279×100

Divide. (Lesson 3.5)

34. $26\overline{)465}$ 35. $36\overline{)7488}$ 36. $75\overline{)1508}$ 37. $63\overline{)25{,}830}$ 38. $19\overline{)1734}$ 39. $43\overline{)2669}$

Convert each measure. (Lesson 4.6)

40. 12.5 L to mL 41. 28,000 mL to L 42. 5 L to mL

Solve.

43. Mr. Andes pays $2268 in real estate taxes each year. How much should he save monthly for next year's tax bill? (Lesson 3.5)

44. A can of fruit juice concentrate holds 350 milliliters. If Phyllis adds 4 cans of water to the concentrate, how many liters of juice will she make? (Lesson 4.6)

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40 Extra Practice & Mixed Review

Name Ke.

Class _____

(Use after completing Lesson 5.3, pp. 114–115)

Date _____ Score _____

▶ Extra Practice (Lesson 5.3)

Fill in the blank to make each whole number an improper fraction.

1. $8 = \frac{\square}{10}$ _____
2. $5 = \frac{\square}{12}$ _____
3. $12 = \frac{\square}{20}$ _____
4. $25 = \frac{\square}{8}$ _____

Write each mixed number as an improper fraction.

5. $3\frac{2}{3}$ _____
6. $12\frac{4}{5}$ _____
7. $9\frac{7}{10}$ _____
8. $20\frac{7}{15}$ _____

Write each quotient as a whole or mixed number.

9. $\frac{27}{10}$ _____
10. $8\overline{)60}$ _____
11. $\frac{18}{4}$ _____
12. $16\overline{)73}$ _____

Solve.

13. Applesauce comes in packages of 4 individual containers. If Louise has 5 full packages and one that is $\frac{3}{4}$ full, how many containers does she have?

_____

14. Emily served 4 pizzas that were each cut into 8 slices. Three whole pizzas and $\frac{3}{8}$ of another were eaten. How many pieces of pizza were eaten?

_____

▶ Mixed Review (Lessons 2.4, 3.6, 5.2)

Multiply. (Lesson 2.4)

15. 237×63
16. 806×44
17. 95×47
18. 108×249
19. 5093×43
20. 2931×739

Divide and show the remainder. (Lesson 3.6)

21. $608{,}341 \div 252$ _____
22. $70{,}459 \div 819$ _____
23. $9060 \div 278$ _____

Use division to find a fraction equivalent to each fraction. (Lesson 5.2)

24. $\frac{5}{10}$ _____
25. $\frac{8}{12}$ _____
26. $\frac{15}{20}$ _____
27. $\frac{18}{27}$ _____
28. $\frac{20}{45}$ _____
29. $\frac{14}{24}$ _____

Solve.

30. A farm has 75 rows of newly planted trees with 54 trees in each row. How many trees are newly planted? (Lesson 2.4)

_____

31. A machine makes batches of 285 buttons. How many complete batches will be made to fill an order for 5500 buttons? How many buttons will be in the last batch? (Lesson 3.6)

_____

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41 Extra Practice & Mixed Review

Name _____

Class _____

(Use after completing Lesson 5.4, pp. 116-117)

Date _____ Score _____

▶ Extra Practice (Lesson 5.4)

Compare. Use <, >, or =.

1. $\frac{7}{12}$ ___ $\frac{6}{12}$
2. $\frac{10}{16}$ ___ $\frac{15}{16}$
3. $\frac{18}{24}$ ___ $\frac{12}{24}$
4. $\frac{26}{30}$ ___ $\frac{29}{30}$
5. $\frac{6}{10}$ ___ $\frac{3}{5}$
6. $\frac{17}{20}$ ___ $\frac{11}{12}$
7. $\frac{7}{12}$ ___ $\frac{7}{16}$
8. $\frac{3}{4}$ ___ $\frac{2}{3}$
9. $8\frac{1}{3}$ ___ $7\frac{7}{8}$
10. $\frac{10}{3}$ ___ $2\frac{5}{6}$
11. $\frac{12}{7}$ ___ $2\frac{1}{4}$
12. $\frac{19}{16}$ ___ $1\frac{1}{4}$
13. $10\frac{3}{5}$ ___ $12\frac{3}{5}$
14. $\frac{15}{4}$ ___ $3\frac{3}{4}$
15. $5\frac{1}{3}$ ___ $3\frac{3}{4}$
16. $1\frac{11}{12}$ ___ $2\frac{1}{6}$

Solve.

17. Courtney has read four-fifths of the assignment, Lisa has read three-fourths of the assignment, and Bonnie has read seven-tenths of the assignment. Who has read the most?

_____

18. Caroline has found three patterns for a costume. One pattern needs $4\frac{3}{8}$ yards of fabric, a second pattern needs $4\frac{1}{2}$ yards of fabric, and a third pattern needs $4\frac{3}{4}$ yards of fabric. Which pattern needs the least amount of fabric?

_____

▶ Mixed Review (Lessons 2.6, 3.9, 5.3)

Estimate the product. (Lesson 2.6)

19. $\begin{array}{r} 59 \\ \times\ 5 \\ \hline \end{array}$
20. $\begin{array}{r} 23 \\ \times\ 18 \\ \hline \end{array}$
21. $\begin{array}{r} 209 \\ \times\ 53 \\ \hline \end{array}$
22. $\begin{array}{r} 815 \\ \times\ 9 \\ \hline \end{array}$
23. $\begin{array}{r} 658 \\ \times\ 68 \\ \hline \end{array}$
24. $\begin{array}{r} 925 \\ \times\ 83 \\ \hline \end{array}$

Simplify. (Lesson 3.9)

25. $3 \times 2 - 5 \times 4$ _____
26. $3 \times (2 + 5) \times 4$ _____
27. $(30 + 5) \div 5 - 2$ _____

Write each mixed number as an improper fraction. (Lesson 5.3)

28. $8\frac{7}{10}$ _____
29. $12\frac{2}{3}$ _____
30. $10\frac{5}{6}$ _____
31. $14\frac{3}{8}$ _____

Solve.

32. Mr. Wick needs 178 feet of fence installed at his house. One company quotes an installation charge of $3.85 per foot. Estimate the installation charge. (Lesson 2.6)

_____

33. Juice comes in packages of 3 cartons. If Scott has 5 full packages and one that is $\frac{2}{3}$ full, how many cartons does he have? (Lesson 5.3)

_____

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42 Extra Practice & Mixed Review

Name _____

Class _____

(Use after completing Lesson 5.5, pp. 118-119)

Date _____ Score _____

▶ Extra Practice (Lesson 5.5)

List the factors.

1. 12 _____
2. 28 _____
3. 16 _____
4. 32 _____
5. 25 _____
6. 38 _____

Find the GCF of each pair of numbers.

7. 12 15 _____
8. 14 21 _____
9. 45 27 _____
10. 63 45 _____
11. 8 19 _____
12. 8 36 _____
13. 24 16 _____
14. 16 20 _____

Solve.

15. Andrea must adjust a packaging machine so that it cuts two rolls of paper into strips of the same width. One roll is 45 centimeters wide and the other roll is 60 centimeters wide. What is the greatest width that the strips can be?

_____

16. Patrick's and Lisa's older brother, Thomas, is 18 years old. The greatest common factor of all of their ages is 6. Lisa is older than Patrick. How old is Patrick? How old is Lisa?

_____

▶ Mixed Review (Lessons 2.7, 3.10, 5.4)

Multiply. (Lesson 2.7)

17. 8.73×100 _____
18. 0.9×1000 _____
19. 0.03×500 _____
20. 6.1×300 _____

Divide. (Lesson 3.10)

21. $8\overline{)16.48}$
22. $93\overline{)3.72}$
23. $16\overline{)80.80}$
24. $6\overline{)42.750}$
25. $7\overline{)7.252}$
26. $35\overline{)175.315}$

Compare. Use <, >, or =. (Lesson 5.4)

27. $\frac{7}{8}$ ____ $\frac{5}{8}$
28. $\frac{6}{10}$ ____ $\frac{3}{5}$
29. $\frac{8}{3}$ ____ $2\frac{1}{3}$
30. $\frac{7}{9}$ ____ $\frac{7}{8}$
31. $5\frac{3}{4}$ ____ $\frac{9}{2}$
32. $\frac{8}{11}$ ____ $\frac{8}{9}$

Solve.

33. Alison bought 20 feet of weather stripping. The weather stripping cost $0.29 a foot. How much did Alison pay? (Lesson 2.7)

_____

34. Thomas received a paycheck for $218.75 for 35 hours of work. How much did he earn per hour? (Lesson 3.10)

_____

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43 Extra Practice & Mixed Review

Name _____

Class _____

(Use after completing Lesson 5.6, pp. 120-121)

Date _____ Score _____

▶ Extra Practice (Lesson 5.6)

Write in lowest terms.

1. $\frac{8}{10}$ _____ 2. $\frac{9}{15}$ _____ 3. $\frac{6}{21}$ _____ 4. $\frac{15}{25}$ _____ 5. $\frac{30}{45}$ _____ 6. $\frac{42}{48}$ _____

7. $\frac{25}{60}$ _____ 8. $\frac{40}{75}$ _____ 9. $\frac{21}{36}$ _____ 10. $\frac{30}{20}$ _____ 11. $\frac{42}{28}$ _____ 12. $\frac{66}{100}$ _____

List the factors and write in lowest terms.

13. $\frac{16}{20}$ _____ 14. $\frac{15}{9}$ _____

Solve.

15. Each evening Barbara spends 15 minutes cleaning the kitchen after dinner. What part of an hour is 15 minutes? Write your answer in lowest terms.

_____

16. Daniel bought 72 plant seedlings. After they were transplanted, 12 seedlings died. What fractional part of the total survived? Write your answer in lowest terms.

_____

▶ Mixed Review (Lessons 2.8, 3.11, 5.5)

Multiply. (Lesson 2.8)

17. 83×0.45 _____ 18. 52×0.026 _____ 19. 8×1.065 _____ 20. 5.003×9 _____

Divide. Round the quotient to the nearest tenth or cent. (Lesson 3.11)

21. $96\overline{)\$581}$ 22. $28\overline{)114.9}$ 23. $19\overline{)106.4}$ 24. $48\overline{)\$3870}$ 25. $52\overline{)\$498}$ 26. $63\overline{)875.6}$

Find the GCF of each pair of numbers. (Lesson 5.5)

27. 12 20 _____ 28. 16 30 _____ 29. 24 42 _____ 30. 17 50 _____

Solve.

31. Stephanie rides her bicycle two and three-tenths miles five times a week. How far does she ride her bicycle in one week? (Lesson 2.8)

_____

32. Nathan wants to buy a video cassette recorder that costs $479.95. If he can pay for it in 6 equal payments, estimate how much he will still owe after making 4 payments. (Lesson 3.11)

_____

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44 Extra Practice & Mixed Review

Name _____

Class _____

(Use after completing Lesson 5.7, pp. 122–123)

Date _____ Score _____

▶ Extra Practice (Lesson 5.7)

Write as a decimal.

1. $\frac{1}{8}$ _____ 2. $\frac{2}{9}$ _____ 3. $\frac{2}{5}$ _____ 4. $8\frac{1}{2}$ _____ 5. $\frac{1}{11}$ _____ 6. $6\frac{1}{3}$ _____

7. $4\frac{3}{4}$ _____ 8. $6\frac{7}{8}$ _____ 9. $3\frac{5}{6}$ _____ 10. $\frac{7}{9}$ _____ 11. $\frac{5}{12}$ _____ 12. $\frac{3}{10}$ _____

13. $15\frac{3}{20}$ _____ 14. $20\frac{2}{7}$ _____ 15. $9\frac{3}{16}$ _____ 16. $17\frac{9}{25}$ _____

Write as a fraction or mixed number in lowest terms.

17. 6.4 _____ 18. 3.9 _____ 19. 0.005 _____ 20. 8.035 _____

Solve.

21. Michael rides his bike to school. The distance is three-fourths of a mile. Write the distance as a decimal.

_____

22. Kimberly needs $\frac{1}{2}$ pound of pecans for a dessert recipe. If she buys a package weighing 0.64 pound, what fractional part of a pound will she have left over?

_____

▶ Mixed Review (Lessons 2.10, 3.12, 5.6)

Multiply. (Lesson 2.10)

23. 0.64×0.401 _____ 24. 8.713×0.061 _____ 25. 0.0088×6.07 _____

Divide. Round to the nearest tenth, if needed. (Lesson 3.12)

26. $2.6\overline{)13.52}$ 27. $0.87\overline{)78.3}$ 28. $0.08\overline{)57.12}$ 29. $0.4\overline{)6.36}$ 30. $9.5\overline{)56.08}$ 31. $5.7\overline{)25.7}$

Write in lowest terms. (Lesson 5.6)

32. $\frac{12}{16}$ _____ 33. $\frac{9}{21}$ _____ 34. $\frac{18}{32}$ _____ 35. $\frac{36}{64}$ _____ 36. $\frac{8}{12}$ _____ 37. $\frac{24}{36}$ _____

Solve.

38. Alice bought 3.19 pounds of apples from the grocery store. If the apples were priced at $0.79 a pound, how much did she pay in all? Round your answer to the nearest cent. (Lesson 2.10)

_____

39. Leslie bought carpeting for the family room. The total cost was $612.75. The price per square yard was $21.50. How many square yards of carpeting did she buy? (Lesson 3.12)

_____

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45 Extra Practice & Mixed Review

Name _____

Class _____

(Use after completing Lesson 6.1, pp. 130–131)

Date _____ Score _____

▶ Extra Practice (Lesson 6.1)

Multiply. Write the answers in lowest terms.

1. $\frac{2}{3} \times \frac{1}{5}$ _____
2. $\frac{7}{8} \times \frac{4}{5}$ _____
3. $\frac{3}{5} \times \frac{7}{12}$ _____
4. $\frac{8}{15} \times \frac{5}{9}$ _____
5. $6 \times \frac{2}{3}$ _____
6. $12 \times \frac{5}{12}$ _____
7. $15 \times \frac{3}{4}$ _____
8. $\frac{13}{16} \times \frac{4}{7}$ _____
9. $\frac{1}{2} \times \frac{7}{10}$ _____
10. $\frac{8}{12} \times \frac{9}{16}$ _____
11. $\frac{1}{4} \times \frac{8}{9}$ _____
12. $10 \times \frac{8}{10}$ _____
13. $\frac{12}{18} \times \frac{6}{12}$ _____
14. $\frac{11}{15} \times \frac{3}{8}$ _____
15. $18 \times \frac{7}{12}$ _____
16. $\frac{5}{9} \times \frac{3}{11}$ _____
17. $8 \times \frac{7}{12}$ _____
18. $\frac{1}{4} \times \frac{9}{10}$ _____
19. $5 \times \frac{7}{10}$ _____
20. $\frac{3}{16} \times \frac{5}{8}$ _____

Solve.

21. Lorna, Dean, Anne, and Steven will equally share a submarine sandwich that is $\frac{3}{4}$ yard long. How long will each person's section of submarine sandwich be?

_____

22. Louis is preparing a recipe that calls for $\frac{3}{4}$ pound of chopped walnuts. He is only making $\frac{1}{2}$ of the recipe. How many chopped walnuts does he need?

_____

▶ Mixed Review (Lessons 4.2, 5.2, 5.7)

Convert each measure. (Lesson 4.2)

23. 82 mm to cm _____
24. 869 m to km _____
25. 0.95 m to cm _____
26. 6 mm to m _____
27. 6.3 cm to mm _____
28. 0.51 km to cm _____

Use division to find a fraction equivalent to each fraction. (Lesson 5.2)

29. $\frac{6}{12}$ _____
30. $\frac{10}{15}$ _____
31. $\frac{8}{18}$ _____
32. $\frac{14}{24}$ _____
33. $\frac{16}{20}$ _____
34. $\frac{10}{25}$ _____

Write as a decimal. (Lesson 5.7)

35. $6\frac{4}{5}$ _____
36. $9\frac{3}{10}$ _____
37. $\frac{2}{3}$ _____
38. $\frac{1}{9}$ _____
39. $5\frac{1}{8}$ _____
40. $7\frac{5}{6}$ _____

Solve.

41. The Brook hiking path is 8.5 kilometers long. The Oak Path hiking trail is 9.2 kilometers long. How many meters longer is the Oak Path trail? (Lesson 4.2)

_____

42. One quart contains 32 ounces. Using equivalent fractions, find how many ounces are in $\frac{1}{2}$ quart. (Lesson 5.2)

_____

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46 Extra Practice & Mixed Review

Name _____

Class _____

(Use after completing Lesson 6.2, pp. 132–133)

Date _____ Score _____

▶ Extra Practice (Lesson 6.2)

Multiply. Write the answers in lowest terms.

1. $\frac{4}{11} \times \frac{3}{4}$ _____
2. $\frac{9}{25} \times \frac{7}{18}$ _____
3. $\frac{11}{30} \times \frac{10}{21}$ _____
4. $\frac{6}{7} \times \frac{7}{9}$ _____
5. $\frac{3}{9} \times \frac{7}{10}$ _____
6. $\frac{8}{12} \times \frac{9}{12}$ _____
7. $\frac{33}{100} \times \frac{3}{6}$ _____
8. $\frac{12}{16} \times \frac{9}{10}$ _____
9. $\frac{8}{16} \times \frac{2}{9}$ _____
10. $\frac{9}{250} \times \frac{50}{80}$ _____
11. $\frac{300}{750} \times \frac{7}{60}$ _____
12. $\frac{8}{20} \times \frac{7}{25}$ _____
13. $\frac{7}{14} \times \frac{42}{49}$ _____
14. $\frac{75}{100} \times \frac{9}{10}$ _____
15. $\frac{22}{27} \times \frac{9}{15}$ _____
16. $\frac{12}{39} \times \frac{26}{35}$ _____

Solve.

17. Jane can walk to the library from school in $\frac{2}{5}$ hour. If she rides her bike, she can get there in $\frac{1}{2}$ the time. How long does it take her to ride her bike to the library?

_____

18. Rosemary uses $\frac{2}{3}$ of her backyard for a vegetable garden. If $\frac{1}{4}$ of the garden is used to grow green beans, what part of the backyard is used to grow green beans?

_____

▶ Mixed Review (Lessons 4.3, 5.3, 6.1)

Complete each statement. Choose the more reasonable measure. (Lesson 4.3)

19. The width of a driveway is 3.5 _____ . m cm

20. The length of a baseball bat is about 1 _____ . m km

Write each mixed number as an improper fraction. (Lesson 5.3)

21. $6\frac{3}{10}$ _____
22. $10\frac{11}{12}$ _____
23. $9\frac{7}{100}$ _____
24. $85\frac{2}{3}$ _____

Multiply. Write the answers in lowest terms. (Lesson 6.1)

25. $\frac{7}{8} \times \frac{1}{2}$ _____
26. $\frac{15}{16} \times \frac{4}{11}$ _____
27. $\frac{13}{20} \times \frac{2}{15}$ _____
28. $\frac{5}{9} \times \frac{20}{35}$ _____

Solve.

29. Carlos is painting a line down the center of a bicycle path. The path is 12 kilometers long. He can paint a line that is 750 meters long with one can of paint. How many cans of paint does he need? (Lesson 4.3)

_____

30. Kevin can take 36 pictures with his camera using one roll of film. If he has a roll in his camera that is $\frac{3}{4}$ used and 2 full rolls of unused film, how many more pictures can he take? (Lesson 5.3)

_____

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47 Extra Practice & Mixed Review

Name _____

Class _____

(Use after completing Lesson 6.4, pp. 136-137)

Date _____ Score _____

▶ Extra Practice (Lesson 6.4)

Multiply. Write the answers in lowest terms.

1. $5\frac{1}{3} \times 3\frac{3}{8}$ _____
2. $\frac{4}{5} \times 6\frac{1}{4}$ _____
3. $3\frac{3}{5} \times 3\frac{3}{4}$ _____
4. $7\frac{4}{5} \times 30$ _____
5. $4 \times 3\frac{1}{5}$ _____
6. $3\frac{3}{13} \times 1\frac{3}{10}$ _____
7. $8\frac{1}{2} \times 1\frac{3}{5}$ _____
8. $2 \times 3\frac{7}{12}$ _____
9. $5 \times 6\frac{9}{10}$ _____
10. $7\frac{1}{2} \times \frac{3}{5}$ _____
11. $2 \times 7\frac{1}{4}$ _____
12. $2\frac{1}{2} \times 1\frac{3}{10}$ _____
13. $3\frac{5}{6} \times 2\frac{1}{3}$ _____
14. $5\frac{3}{4} \times 1\frac{1}{3}$ _____
15. $6\frac{2}{3} \times \frac{1}{2}$ _____
16. $3\frac{1}{2} \times \frac{3}{8}$ _____
17. $2\frac{3}{8} \times 1\frac{1}{3}$ _____
18. $8\frac{1}{3} \times 2\frac{1}{4}$ _____
19. $1\frac{1}{7} \times 2\frac{1}{4}$ _____
20. $4\frac{1}{2} \times 3\frac{7}{12}$ _____

Solve.

21. Each pair of curtains needs $2\frac{1}{4}$ yards of fabric. How many yards of fabric are needed for 5 pairs of curtains?

_____

22. A punch recipe calls for $2\frac{1}{2}$ quarts of fruit juice. If Mark wants to make $1\frac{1}{2}$ times the recipe, how much juice does he need?

_____

▶ Mixed Review (Lessons 4.5, 5.4, 6.2)

Convert each measure. (Lesson 4.5)

23. 7 kg to g _____
24. 58 g to mg _____
25. 1281 mg to g _____
26. 84.9 kg to g _____
27. 7039 g to kg _____
28. 433 g to kg _____

Compare. Use <, >, or =. (Lesson 5.4)

29. $\frac{6}{7}$ _____ $\frac{11}{12}$
30. $3\frac{6}{11}$ _____ $3\frac{12}{22}$
31. $4\frac{7}{10}$ _____ $4\frac{3}{4}$
32. $9\frac{3}{4}$ _____ $9\frac{3}{5}$

Multiply. Write the answers in lowest terms. (Lesson 6.2)

33. $\frac{3}{8} \times \frac{4}{9}$ _____
34. $\frac{7}{8} \times \frac{4}{5}$ _____
35. $\frac{7}{32} \times \frac{3}{7}$ _____
36. $\frac{4}{5} \times \frac{5}{6}$ _____

Solve.

37. Miss Wallace bought six kilograms of grapes to be divided among 30 students. How many grams of grapes did each student get? (Lesson 4.5)

_____

38. Josephine bought $2\frac{7}{8}$ pounds of cherries, $2\frac{1}{2}$ pounds of strawberries, and $2\frac{3}{4}$ pounds of blueberries. Which of these fruits weighed the most? (Lesson 5.4)

_____

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ASSERTIVE COMMUNICATION SKILLS

AGGRESSIVE		ASSERTIVE
Why are you late?	VS	What prevented you from getting here on time?

Sample #1 Aggressive Behavior Analysis:

In this situation, the aggressive response places a rift between the people involved before they even begin to approach a resolution to the problem. In addition, the aggressive response assumes the worst of an individual before giving them the benefit of the doubt. Furthermore, the aggressive response creates feelings of being attacked, thus causing the individual to become defensive and unwilling to communicate effectively. Lastly, the aggressive response is clearly confrontative and will result in a breakdown of communication.

Sample #1 Assertive Behavior Analysis:

In this situation, the assertive response demonstrates respect as well as open-mindedness. The assumption is that the individual didn't elect to purposely be late. The assertive response allows successful communication to ensue.

AGGRESSIVE		ASSERTIVE
I need to talk now!	VS	I know it may not be a good time to talk, but I'd really like to know how you feel and to clear the air between us.

Sample #2 Aggressive Behavior Analysis:

The aggressive response in this situation creates once again feelings of being attacked. The response is clearly confrontative. Also, a definite impasse will ensue in this situation due to the disrespect that is displayed toward the other person's feelings as well as their time. The message given in the aggressive response is that my feelings and my time are the only important factors here. In this situation, any attempt to arrive at an integrative solution is fruitless.

Sample #2 Assertive Behavior Analysis:

The assertive response in this situation reveals to the other person the willingness to clear the air and resume a workable relationship. This approach is made in a friendly, nonconfrontative way.

Developed by Melody L. Fitzpatrick-Parke
1994

TWELVE

According to your belief

How many times have you affirmed some good that you desired, (a fulfilling relationship, a better job, a new home, etc.), but never received it? This is because deep inside, you believed that you weren't worthy. According to your belief, so it is done unto you.

Think of the universe as an ocean. You may approach the ocean for water with a teaspoon or a bucket. The ocean in its vastness doesn't care what vessel you use or how much you take from it. It has more nourishment to give than you could ever require. What defines the amount of water you receive is the size of the container that you bring. What defines your supply is what you can accept in your innermost heart.

Ask yourself, "What am I bringing to my universe? Is it a teaspoon, a bucket, or a ten-gallon jar? What led me to decide which container I am using? *What do I think I deserve?*"

The universe wants to provide for your every need. Your task is to uncover and transform those limiting beliefs that have prevented you from accepting the good that is your birthright. To do this, you must learn to love yourself as much as you are loved by the Divine.

When you have achieved this self– love, then success, prosperity, and abundance will open before you.

ACTIVITY II

RECOGNIZING ROLES OF ASSERTIVENESS AND PASSIVENESS

REFLECTIVE WAY: **BEHAVIORS**
Learning Objective: Learners will understand assertive submissive, and aggressive behaviors

UNDERSTANDING WHY:

There are three basic ways that we relate to others. These are submissive, aggressive, or assertive behaviors. Do you know what these words mean? When is it appropriate to use each of the styles? We may use one type of behavior with some people and another with others. Why do we do this? Where do we learn our behavior patterns? Is it possible to change our behaviors, and if so what would be some of things that would help us along the way?

UNDERSTANDING HOW:

1. Learners define Submissive, Assertive, and Aggressive on the board.
2. The facilitator hands out the three "Behaviors "worksheets. Learners generate examples of each of the different behaviors.

Worksheet

SUBMISSIVE BEHAVIOR

People who act submissively often do not have respect for their own rights. Many of these people do not express their honest feelings, needs, values, and concerns. They allow others to violate their space, deny their rights, and ignore their needs. Other people who show submissive behavior do express their needs, but in such a gentle way that they are not taken seriously.

1. What would be an example of submissive behavior?

   _____

   _____

2. What are some of the possible reasons why people might act submissively?

   _____

   _____

3. Write about a time when you saw someone being submissive.

   _____

   _____

4. Think about this submissive behavior. What are some of the options that this person could have exercised at the time?

   _____

   _____

Worksheet

AGGRESSIVE BEHAVIORS

People who express themselves aggressively do so at the expense of others. They usually win arguments. They may speak very loudly and with confidence. An aggressive person will tend to dominate others and win respect by creating a climate of awe or fear.

1. What would be an example of aggressive behavior?

   _____

   _____

2. Why would a person such as a young child decide that aggressive behavior was the best way to interact with people?

   _____

   _____

3. What are some of the prices that an aggressive person has to pay for their power and control?

   _____

   _____

4. Tell the story of someone's aggressive behavior:

   _____

   _____

   _____

Worksheet

ASSERTIVE BEHAVIOR

People who are assertive are able to express themselves and have their needs met without dominating others. True assertiveness is a way of being in the world which confirms individual worth and dignity while simultaneously confirming and maintaining the worth of others. The assertive person stands up for his or her own rights and expresses his or her personal needs, values, concerns, and ideas in direct and appropriate ways.

1. What is an example of assertive behavior?

   _____

   _____

   _____

2. What are some of the things that a submissive person would have to overcome to become assertive?

   _____

   _____

3. What are some of the things that an aggressive person would have to overcome to take on an assertive style of communication?

   _____

   _____

   _____

4. "It's best for women to be submissive and for men to be aggressive." How do you feel about this statement?

   _____

   _____

INTERACTIVE WAY: **LEARNING TO BE ASSERTIVE**
Learning Objective: Learners will recognize roles of assertiveness, submissiveness, and aggressiveness in others

UNDERSTANDING WHY:

If someone were to identify what type of person you are, what would they say? Would they say that you a meek, nice, passive type? Would they say that you are overbearing and aggressive? Or would they say that you are assertive and active? What are the differences between these types of people? Are we born into these behavior patterns or do we develop them as a way to cope with the environments in which we have lived? How might they be a combination of both?

UNDERSTANDING HOW:

1. Learners read the "Understanding Why" and consider how people's personalities develop.
2. Learners break into pairs and discuss the "Police Incident" worksheet.
3. The facilitator can pose the question; can we maintain our dignity without becoming aggressive in the face of another aggressive person or system? How?

PROBLEM POSING WAY: **HOW DO YOU RESPOND ?**
Learning Objective: Learners will recognize aggressive, assertive, and passive behavior patterns

UNDERSTANDING WHY :

Is it true that we put up with other people's behavior depending on our own frame of mind and disposition at the moment? For example, on one day you may be sitting on the bus and some people are talking crazy in back of you. You may smile and listen to their conversation and even laugh. Another day, however, the same people could be in back of you, talking about the same thing, in the same way, and you just click! You find them annoying and rude; you start shouting at them and tell them to shut up. What might be the difference between the two days? What are some of the factors which might be influencing your behavior?

UNDERSTANDING HOW :

1. Learners are broken into groups of three.
2. Learners read the "How Do You Respond?" worksheet and generate examples of the three styles of responses.
3. Each group role-plays their examples in front of the class. The class decides which type of behavior is being performed.

Worksheet

HOW DO YOU RESPOND?

Look at the situations below. In groups of three, think of how people using a submissive, aggressive, and assertive behavior would react in the following situations. Follow the example given.

EXAMPLE:	**You are sitting in a movie theater, and two teenagers are laughing and talking in back of you.**
Submissive:	Sit and not say anything, but then get very frustrated and angry later with someone else.
Aggressive:	"Shut up or I'll have you thrown out of here!"
Assertive:	"Your talking is distracting me from hearing the movie. Would you mind lowering your voices or moving?"

1. EXAMPLE: **Someone cuts in line in front of you.**

Submissive: _____

_____

Aggressive: _____

_____

Assertive: _____

_____

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CONTENT BASED WAY: **YOUR COMMUNICATION STYLE**
Learning Objective: Learners will recognize their personal communication style

UNDERSTANDING WHY:

We all, to one degree or another, use either submissive or aggressive behavior. One of the most noticeable things about assertive people is that they seem to strike a balance. They are expressing their needs and desires without offending others. They are usually involved in meaningful and varied types of relationships, are less preoccupied by self-consciousness and anxiety, and less driven by the needs of self protection or control. The assertive person listens to others and then responds honestly.

UNDERSTANDING HOW:

1. Learners are handed the "Behaviors" worksheet.
2. Learners answer the questions.
3. Learners break into small groups and share their answers.

Worksheet

BEHAVIORS

ANSWER THE FOLLOWING QUESTIONS:

1. What do you think your overall behavior style is?

   _____

   _____

2. When might it be appropriate to use submissive behavior?

   _____

   _____

3. When are times when it might be appropriate to use aggressive behavior?

   _____

   _____

4. In what situations do you think it is "okay" to use aggressive behavior?

   _____

   _____

5. What are the advantages of using assertive behavior?

   _____

   _____

6. Our communication style often grows out of what we learned was the proper behavior for our sexual roles. Do you believe that is true? Give examples of why, or why not.

   _____

   _____

SHEET METAL WORKERS ROLE PLAY

Shop Foreman/Supervisor goes through your personal tool box without asking and pulls out several tools that he feels are damaged or faulty. When you arrive at work in the morning, he approaches you, with tools in hand, not only in a confrontative manner, but also right in front of the group. He begins verbally assaulting you on the state of your tools. He tells you that many of your tools are dull, your handles are broken, your chisels have mushroom heads, and many of your blades are bent. At this point you know he is being over zealous in finding fault. Before you even have a chance to respond, he further states that you have an irresponsible attitude toward shop safety, and if you don't do something about the problem by the end of the day you are fired! He then proceeds to walk off throwing your tools to the floor.

SUBMISSIVE/PASSIVE RESPONSE

AGGRESSIVE RESPONSE

PASSIVE/AGGRESSIVE RESPONSE

ASSERTIVE RESPONSE

Developed by Melody L. Fitzpatrick-Parke
1994

Practical Applications

Percentage Problem Solving

Name _____

1. A sheet metal worker earns $ 28.64 an hour. If he receives a 3½ % pay raise, what is the amount of his raise?

What is his new hourly rate?

2. If 5.45% of a sheet metal worker's salary is withheld for Social Security, what amount is withheld from earnings of $ 945.00?

3. On a cutting operation 2 sq. ft. of sheet steel is wasted for every 16 sq. ft. used. What is the percent of waste?

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4. After heating, a metal rod has expanded 3.5% to 15¼ inches. What was its original length?

5. Four pounds of a certain bronze alloy is 1/6 tin, 0.02 zinc, and the rest copper. Express the portion of each metal in percents.

Express the portion of each metal in pounds.

6. If a certain kind of solder is 52% tin, how many pounds of tin are needed to make 20 lbs of solder?

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FRACTIONS

FOR SHEET METAL WORKERS

Building Essential Skills
for the Ohio Building and Construction Industry

Sheet Metal Workers
Cleveland, Ohio

Joe Stastny
Martha J. Ghenne

FRACTIONS FOR SHEET METAL WORKERS

Unit Objectives

At the completion of this unit, the learner will demonstrate knowledge, skills, and attitudes necessary to show understanding of fractions, fractional parts, and various mathematical operations using fractions, mixed numbers, whole numbers and problem solving.

Introduction

The word *fraction* comes from the Latin meaning *to break*. Fractional numbers are used when a standard unit is broken down into parts.

A fraction has two terms, the **numerator** and the **denominator**, with a line separating the two numbers. The numerator refers to the numbers above the line and indicates the given number of parts. The denominator refers to the number below the line and indicates the total number of parts the unit is divided into.

$$\frac{4 \text{ = numerator}}{7 \text{ = denominator}}$$

Proper and Improper Fractions

A proper fraction is one in which the numerator is less than the denominator, such as

2/4 3/7 8/15 49/99

An improper fraction is one in which the denominator is less than the numerator, such as

3/2 6/5 65/41 79/4

A mixed number can be made from improper fractions by dividing the numerator by the denominator and putting the remainder over the denominator.

$$-\frac{13}{5} = 5\overline{)13}\ \begin{matrix} 2\ \tfrac{3}{5} \\ -10 \\ \hline 3 \end{matrix}$$

Appendix E:

Sample Curricula/ Instructional Materials

Collected from Sites

38 Extra Practice & Mixed Review

Name Key

Class _____

(Use after completing Lesson 4.7, pp. 98–99)

Date _____ Score _____

▶ Extra Practice (Lesson 4.7)

Use the table at the right to answer the following questions.

Year	Faron's Salary	Daniel's Salary
1980	$13,000	$11,500
1981	14,000	12,500
1982	15,500	13,000
1983	16,500	14,000
1984	18,000	15,500
1985	20,000	17,000
1986	22,500	19,500
1987	24,500	21,500
1988	26,500	22,500
1989	28,000	23,500

1. What information is presented in the table? How many years are shown?

_____

2. In what year did Faron earn $16,500?

_____

3. What was the increase in Faron's salary from 1980 to 1982? In Daniel's?

_____

4. What were the increases in Faron's salary each year, from 1980 to 1985?

_____

5. What is Daniel's salary in 1989? What is Faron's salary? Who earns more money?

_____

6. What was the increase in Daniel's salary from 1983 to 1986? From 1987 to 1989?

_____

7. How much money did Faron earn from 1980 through 1989? How much did Daniel earn?

_____

8. How much more is Daniel making in 1989 than in 1984?

_____

9. How much more than Daniel did Faron earn from 1980 through 1989?

_____

▶ Mixed Review (Lessons 3.5, 3.7)

Divide. (Lesson 3.5)

10. $38\overline{)1938}$

11. $32\overline{)2244}$

12. $33\overline{)37,037}$

13. $25\overline{)53,545}$

Use *Read, Plan, Do,* and *Check* to solve. (Lesson 3.7)

14. Paul had some hats. He bought four more. He gave Ben two. Greg gave him one. He now has nine hats. How many did he start with?

_____

15. Lauren runs around the track in 60 seconds. It takes Justin 40 seconds. If they start together, when will their paths cross again?

_____

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39 Extra Practice & Mixed Review

Name Key

Class _____

(Use after completing Lesson 5.2, pp. 112-113)

Date _____ Score _____

▶ Extra Practice (Lesson 5.2)

Find 3 fractions equivalent to each fraction.

1. $\frac{1}{3}$ _____ 2. $\frac{1}{5}$ _____ 3. $\frac{7}{8}$ _____ 4. $\frac{5}{6}$ _____ 5. $\frac{7}{5}$ _____ 6. $\frac{11}{8}$ _____

7. $\frac{3}{2}$ _____ 8. $\frac{3}{8}$ _____ 9. $\frac{5}{3}$ _____ 10. $\frac{7}{9}$ _____ 11. $\frac{9}{8}$ _____ 12. $\frac{4}{3}$ _____

Use division to find a fraction equivalent to each fraction.

13. $\frac{4}{12}$ _____ 14. $\frac{10}{12}$ _____ 15. $\frac{18}{20}$ _____ 16. $\frac{15}{18}$ _____ 17. $\frac{21}{24}$ _____ 18. $\frac{30}{50}$ _____

19. $\frac{14}{16}$ _____ 20. $\frac{20}{24}$ _____ 21. $\frac{10}{16}$ _____ 22. $\frac{30}{20}$ _____ 23. $\frac{12}{10}$ _____ 24. $\frac{10}{8}$ _____

Solve.

25. There are 12 inches in a foot. Using equivalent fractions, find how many inches are in $\frac{2}{3}$ foot.

_____

26. A parking lot is divided into 150 stalls. Using equivalent fractions, find how many stalls are in $\frac{3}{5}$ of the parking lot.

_____

▶ Mixed Review (Lessons 2.3, 3.5, 4.6)

Multiply mentally. (Lesson 2.3)

27. 8×100 _____ 28. 12×1000 _____ 29. 30×15 _____ 30. 60×300 _____

31. $83 \times 10{,}000$ _____ 32. 53×2000 _____ 33. 279×100 _____

Divide. (Lesson 3.5)

34. $26\overline{)465}$ 35. $36\overline{)7488}$ 36. $75\overline{)1508}$ 37. $63\overline{)25{,}830}$ 38. $19\overline{)1734}$ 39. $43\overline{)2669}$

Convert each measure. (Lesson 4.6)

40. 12.5 L to mL _____ 41. 28,000 mL to L _____ 42. 5 L to mL _____

Solve.

43. Mr. Andes pays $2268 in real estate taxes each year. How much should he save monthly for next year's tax bill? (Lesson 3.5)

_____

44. A can of fruit juice concentrate holds 350 milliliters. If Phyllis adds 4 cans of water to the concentrate, how many liters of juice will she make? (Lesson 4.6)

_____

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40 Extra Practice & Mixed Review

Name Ke

Class _____

(Use after completing Lesson 5.3, pp. 114-115)

Date _____ Score _____

▶ Extra Practice (Lesson 5.3)

Fill in the blank to make each whole number an improper fraction.

1. $8 = \frac{\square}{10}$ _____
2. $5 = \frac{\square}{12}$ _____
3. $12 = \frac{\square}{20}$ _____
4. $25 = \frac{\square}{8}$ _____

Write each mixed number as an improper fraction.

5. $3\frac{2}{3}$ _____
6. $12\frac{1}{5}$ _____
7. $9\frac{7}{10}$ _____
8. $20\frac{7}{15}$ _____

Write each quotient as a whole or mixed number.

9. $\frac{27}{10}$ _____
10. $8\overline{)60}$ _____
11. $\frac{18}{4}$ _____
12. $16\overline{)73}$ _____

Solve.

13. Applesauce comes in packages of 4 individual containers. If Louise has 5 full packages and one that is $\frac{3}{4}$ full, how many containers does she have?

_____

14. Emily served 4 pizzas that were each cut into 8 slices. Three whole pizzas and $\frac{3}{8}$ of another were eaten. How many pieces of pizza were eaten?

_____

▶ Mixed Review (Lessons 2.4, 3.6, 5.2)

Multiply. (Lesson 2.4)

15. 237×63
16. 806×44
17. 95×47
18. 108×249
19. 5093×43
20. 2931×739

Divide and show the remainder. (Lesson 3.6)

21. $608{,}341 \div 252$ _____
22. $70{,}459 \div 819$ _____
23. $9060 \div 278$ _____

Use division to find a fraction equivalent to each fraction. (Lesson 5.2)

24. $\frac{5}{10}$ _____
25. $\frac{8}{12}$ _____
26. $\frac{15}{20}$ _____
27. $\frac{18}{27}$ _____
28. $\frac{20}{45}$ _____
29. $\frac{14}{24}$ _____

Solve.

30. A farm has 75 rows of newly planted trees with 54 trees in each row. How many trees are newly planted? (Lesson 2.4)

_____

31. A machine makes batches of 285 buttons. How many complete batches will be made to fill an order for 5500 buttons? How many buttons will be in the last batch? (Lesson 3.6)

_____

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Conversely, to change a mixed number to an improper fraction multiply the whole number by the denominator and add the numerator.

$$2\frac{3}{5} = 2 \times 5 = 10 + 3 = \frac{13}{5}$$

*Practice

(Allow learners to do some practice involving proper fractions, improper fractions, and mixed numbers.

Equivalent Fractions

Equivalent fractions are fractions that represent the same number.

1/2 = 3/6 = 4/8

Multiply the numerator and denominator by the same number to get equivalent fractions.

3/4 = ?/20 = 9/?

*Practice

Reducing Fractions

Reducing fractions is done by dividing a numerator and denominator by the same number.

4/12 = 1/? = ?/6

Reducing a fraction to lowest terms is to divide a fraction until there is no number that will divide equally into the numerator and denominator.

*Practice

Comparing fractions is accomplished by finding a common denominator and then comparing the numerators after multiplying.

Compare 2/3 and 5/8:

$$\frac{2}{3} \times \frac{8}{8} = \frac{16}{24} \qquad - \qquad \frac{5}{8} \times \frac{3}{3} = \frac{15}{24}$$

2/3 is a larger fraction because 16 is greater than 15.

*Practice

Complete Skill Building Sheet #1.

Multiplication of Fractions

Multiplying fractions is the simplest operation because nothing has to be done to the numbers except in the case of mixed numbers which need to become improper fractions.

1/2 x 1/3 = 1/6

Simply multiply the numerators together, than the denominators together and write the new fraction, reducing if possible.

Cancellation can be used in multiplications of fractions either before multiplying or after.

5/6 x 2/3 = 5/9

5/6 x 2/3 = 10/18 = 5/9

*Practice

Multiplying with whole numbers can be done by first changing the whole number into a fraction, putting it over the number 1.

3 x 4/5

3/1 x 4/5 = 12/5 = 2 2/5

Mixed numbers also have to be changed into improper fractions before multiplying.

2 3/4 x 7/8

11/4 x 7/8 = 77/32 = 2 13/32

*Practice

Division with Fractions

The symbol for division is ÷ , which means divided by. So the statement 2/3 ÷ 1/2 reads two thirds divided by one half. In dividing fractions the second number is the divisor and the divisor is always *inverted*, or turned around and the sign changed to multiplication, so that 2/3 divided by 1/2 now becomes 2/3 times 2/1.

2/3 ÷ 1/2 = 2/3 x 2/1 = 4/3 = 1 1/3

*Practice

Addition and Subtraction with Fractions

These two operations cannot be done with fractions unless the denominators are the same. Once the denominators are alike, add or subtract depending on the sign.

2/7	7/10
+ 3/7	- 2/10
5/7	5/10 = 1/2

$$\begin{array}{rll} 4/9 & = & 4/9 \\ +\ 2/3 & & 6/9 \\ \hline & & 10/9 \end{array} \quad = \quad 1\ 1/9$$

$$\begin{array}{rll} 7\ 2/3 & = & 7\ 4/6 \\ +\ 4\ 5/6 & = & 4\ 5/6 \\ \hline & & 11\ 9/6 \end{array} \quad = \quad 12\ 3/6 \quad = \quad 12\ 1/2$$

*Practice

Complete Skill Building Sheet #2.

Practical Applications

Led by the Union Trainer, the class will discuss and solve situations on the job which involve working with fractions. Some of these situations will include:

-Measuring sheets of metal

-Computing the correct calculations for cutting pieces of sheet metal containing heels and cheeks

-Determining the diameters of duct openings using a fractional number for pi

The lesson will conclude with a competition between the class groups to solve a working problem involving an on the job application in measuring sheet metal.

SKILL BUILDING #1 NAME _____

A. WRITE AS AN IMPROPER FRACTION:

1. $2\frac{1}{3}$ 2. $2\frac{2}{9}$

3. $4\frac{5}{6}$ 4. $9\frac{3}{15}$

B. WRITE AS A MIXED NUMBER:

5. $\frac{4}{3}$ 6. $\frac{11}{8}$

7. $\frac{5}{2}$ 8. $\frac{80}{32}$

C. REDUCE TO LOWEST TERMS:

9. $\frac{6}{16}$

10. $\frac{10}{35}$

11. $\frac{38}{24}$

D. COMPLETE:

12. $\frac{7}{8} = \frac{\quad}{16}$ 13. $2\frac{5}{8} = \frac{\quad}{16}$

E. WHICH IS LARGER?

14. $\frac{3}{4}$ or $\frac{13}{16}$ 15. $1\frac{1}{5}$ or $\frac{8}{7}$

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

NUMBER CORRECT _____

SKILL BUILDING #2

NAME _____

DO THE FOLLOWING OPERATIONS:

1. $\frac{9}{16} \times \frac{4}{3}$

2. $\frac{3}{8} \times 4$

3. $8 \div \frac{3}{4}$

4. $\frac{3}{32} + \frac{1}{8}$

5. $3\frac{1}{2} - 2\frac{1}{3}$

6. $2\frac{2}{3} \times 4\frac{3}{8}$

7. $1\frac{1}{2} + 3\frac{1}{4} + 3\frac{1}{5}$

8. $\frac{1}{2} \div \frac{1}{4}$

9. $3\frac{1}{5} \div 1\frac{5}{7}$

10. $\frac{5}{8} + \frac{1}{10}$

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

NUMBER CORRECT _____

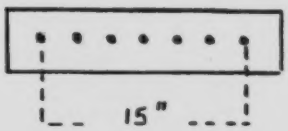
FRACTIONS

PROBLEM SOLVING FOR SHEET METAL WORKERS NAME _____

1. Which is thicker, a 3/16 inch of sheet metal or a 13/64 inch fastener?

2. Tom's piece of metal measures 15 6/8 inches. Express this measurment in lowest terms.

3. In the sheet metal part shown, the seven rivets are equally spaced. Write the distance between rivets as a mixed number.



4. How long will it take to weld 44 lengths of duct if each weld takes 3 1/2 minutes?

5. How long of a bolt is needed to go through a piece of tubing 5/8 inch, a washer 1/16 inch thick and a nut 1/4 inch thick?

6. Four sheets of metal are stacked in a pile. If the thicknesses of the sheets are 7/32, 7/16, 3/8, and 1/4, what is the total thickness of the stack?

7. A tapered shaft is 2 7/16 inches in diameter at one end and 1 3/32 inches at the other. What is the difference in diameter?

8. A special type washer is stamped from a steel strip. If 15/16 inch is required for one washer, how much of the steel strip will be required to make 5000 washers?

9. How many sheets of metal, each 1/32 inch thick, are there in a pile 8 3/8 inches high?

10. How many pieces of metal, each 3/4 inch in length can be cut from a strip 75 inches long, assuming there is no waste in cutting?

2 Fractions

PROBLEM SET 2

40 Fractions

Answers are on page 546.

A. Write as an improper fraction:

1. $1\frac{1}{8}$ 2. $4\frac{1}{5}$ 3. $1\frac{2}{3}$ 4. $2\frac{3}{16}$

5. $3\frac{3}{32}$ 6. $2\frac{1}{16}$ 7. $1\frac{5}{8}$ 8. $3\frac{7}{16}$

Write as a mixed number:

9. $\frac{10}{4}$ 10. $\frac{19}{2}$ 11. $\frac{25}{3}$ 12. $\frac{9}{8}$

13. $\frac{25}{16}$ 14. $\frac{21}{16}$ 15. $\frac{35}{4}$ 16. $\frac{7}{3}$

Reduce to lowest terms:

17. $\frac{6}{32}$ 18. $\frac{8}{32}$ 19. $\frac{12}{32}$ 20. $\frac{18}{24}$

21. $\frac{5}{30}$ 22. $1\frac{12}{21}$ 23. $1\frac{16}{20}$ 24. $3\frac{10}{25}$

Complete these:

25. $\frac{3}{4} = \frac{?}{12}$ 26. $\frac{7}{16} = \frac{?}{64}$ 27. $2\frac{3}{4} = \frac{?}{16}$ 28. $1\frac{3}{8} = \frac{?}{32}$

29. $5\frac{2}{3} = \frac{?}{12}$ 30. $1\frac{4}{5} = \frac{?}{10}$ 31. $1\frac{1}{4} = \frac{?}{12}$ 32. $2\frac{3}{5} = \frac{?}{10}$

Circle the large number:

33. $\frac{7}{16}$ or $\frac{2}{15}$ 34. $\frac{2}{3}$ or $\frac{4}{7}$ 35. $\frac{13}{16}$ or $\frac{7}{8}$ 36. $1\frac{1}{4}$ or $\frac{7}{6}$

37. $\frac{13}{32}$ or $\frac{3}{5}$ 38. $\frac{2}{10}$ or $\frac{3}{16}$ 39. $1\frac{7}{16}$ or $\frac{7}{4}$ 40. $\frac{3}{32}$ or $\frac{1}{9}$

B. Multiply or divide as shown:

1. $\frac{1}{2} \times \frac{3}{16}$ 2. $\frac{3}{4} \times \frac{2}{3}$ 3. $\frac{7}{16} \times \frac{4}{3}$ 4. $\frac{15}{64} \times \frac{1}{12}$

5. $1\frac{1}{2} \times \frac{5}{6}$ 6. $3\frac{1}{16} \times \frac{1}{5}$ 7. $\frac{3}{16} \times \frac{5}{12}$ 8. $14 \times \frac{3}{8}$

9. $\frac{3}{4} \times 10$ 10. $\frac{1}{2} \times 1\frac{1}{3}$ 11. $18 \times 1\frac{1}{2}$ 12. $16 \times 2\frac{1}{8}$

Name

Date

Course/Section

13. $2\frac{2}{3} \times 4\frac{3}{8}$ 14. $3\frac{1}{8} \times 2\frac{2}{5}$ 15. $\frac{1}{2} \div \frac{1}{4}$ 16. $\frac{2}{5} \div \frac{1}{2}$

17. $4 \div \frac{1}{8}$ 18. $8 \div \frac{3}{4}$ 19. $\frac{2}{3} \div 4$ 20. $1\frac{1}{2} \div 2$

21. $3\frac{1}{2} \div 5$ 22. $1\frac{1}{4} \div 1\frac{1}{2}$ 23. $2\frac{3}{4} \div 1\frac{1}{8}$ 24. $3\frac{1}{5} \div 1\frac{5}{7}$

C. Add or subtract as shown:

1. $\frac{3}{8} + \frac{7}{8}$ 2. $\frac{1}{2} + \frac{3}{4}$ 3. $\frac{3}{32} + \frac{1}{8}$ 4. $\frac{3}{8} + 1\frac{1}{4}$

5. $\frac{3}{5} + \frac{5}{6}$ 6. $\frac{5}{8} + \frac{1}{10}$ 7. $\frac{9}{16} - \frac{3}{16}$ 8. $\frac{7}{8} - \frac{1}{2}$

9. $\frac{11}{16} - \frac{1}{4}$ 10. $\frac{5}{6} - \frac{1}{5}$ 11. $\frac{7}{8} - \frac{3}{10}$ 12. $1\frac{1}{2} - \frac{3}{32}$

13. $2\frac{1}{8} + 1\frac{1}{4}$ 14. $1\frac{5}{8} + \frac{13}{16}$ 15. $6 - 1\frac{1}{2}$ 16. $3 - 1\frac{7}{8}$

17. $3\frac{2}{3} - 1\frac{7}{8}$ 18. $2\frac{1}{4} - \frac{5}{6}$ 19. $\frac{1}{2} + \frac{1}{3} + \frac{1}{5}$ 20. $1\frac{1}{2} + 1\frac{1}{4} + 1\frac{1}{5}$

21. $3\frac{1}{2} - 2\frac{1}{3}$ 22. $2\frac{3}{5} - 1\frac{4}{15}$ 23. $2 - 1\frac{3}{5}$ 24. $4\frac{5}{6} - 1\frac{1}{2}$

DECIMALS

FOR SHEET METAL WORKERS

Building Essential Skills
for the Ohio Building and Construction Industry

Sheet Metal Workers
Cleveland, Ohio

Joe Stastny
Martha J. Ghenne

DECIMALS FOR SHEET METAL WORKERS

Unit Objectives

At the completion of this unit, the learner will demonstrate knowledge, skills, and attitudes necessary to show understanding of decimal numbers. The unit will cover addition, subtraction, multiplication and division of decimals. It will also explain changing decimals to fractions and fractions to decimals and will conclude with practical applications of working with decimals numbers in the sheet metal industry.

Introduction

A *decimal number* is a fraction whose denominator is 10 or some multiple of 10. This number can have both a whole-number part and a fractional part. In this instance, the number 45.76 means

45 and 76/100

The whole number part is left of the decimal point and the fractional part is to the right.

Each digit in a number, whether it is a whole number or a fractional part written as a decimal, has a place value name:

3	6	4	9	.	1	5	7	2
thousands	hundreds	tens	ones		tenths	hundredths	thousandths	ten thousandths

*Note that digits to the right of the decimal point end in *th*.

The number above would be spoken as *three thousand six hundred forty nine and one thousand five hundred seventy two ten thousandths.*

.8 would be eight tenths

.36 would be thirty six hundredths

6.375 would be six and three hundred seventy five thousandths

*Practice writing several decimal numbers.

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A zero which comes between a decimal point and another number has value:

To write three hundredths, a zero must hold the tenths place, as shown:

.03 = three hundredths

A zero which comes at the end of a decimal number, has no value and does not change the value of the decimal number.

.35 = thirty five hundredths

.350 = thirty five hundredths

.3500 = thirty five hundredths

*Practice

Addition and Subtraction of Decimal Numbers

These two operations can be done with decimals numbers in the same manner as with whole numbers as long as the decimal points are lined up vertically.

To add .34 and 6.2, simply write as an addition problem and line up the decimals like this:

$$\begin{array}{r} .34 \\ +6.2 \\ \hline \end{array}$$

then add the numbers, bringing down the decimal point to the answer.

$$\begin{array}{r} .34 \\ +6.2 \\ \hline 6.54 \end{array}$$

The same problem could have been written using zeroes to hold the places, as such:

$$\begin{array}{r} 0.34 \\ +6.20 \\ \hline 6.54 \end{array}$$

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Subtraction is done the same way, writing the problem as with whole numbers but lining up the decimal points and bringing a decimal point down into the answer.

Subtract 34.21 from 978.868

$$\begin{array}{r} 978.868 \\ -\ 34.21 \\ \hline 944.658 \end{array} \quad \text{or} \quad \begin{array}{r} 976.868 \\ -\ 034.210 \\ \hline 944.658 \end{array}$$

Carrying in addition problems with decimals and borrowing in subtraction problems with decimals is accomplished just as when working with whole numbers.

$$\begin{array}{r} 68.109 \\ +\ 7.983 \\ \hline 76.092 \end{array} \qquad \begin{array}{r} 37.66 \\ -19.87 \\ \hline 17.79 \end{array}$$

*Note: When adding or subtracting whole numbers and decimal numbers, the places can be filled with zeroes.

*Practice

Then, complete Skill Building Sheet #1

Multiplying with Decimals

Multiplication of decimal numbers is the same as with whole numbers, however the decimal point in the answer is counted over from the left as many places as in both the multiplier and the multiplicand.

$$\begin{array}{rl} 6.04 & = \text{multiplicand (2 places)} \\ \times\ .2 & = \text{multiplier (1 place)} \\ \hline 1.208 & \text{(3 places)} \end{array}$$

*Practice

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Division with Decimals

quotient or answer

divisor) dividend

If only the dividend contains a decimal number, then division is carried out as with whole numbers, remembering to place a decimal point in the answer exactly above the decimal point in the dividend:

$$45\overline{)76.5}\quad \text{(answer: } 1.7\text{)}$$

However, if the decimal point is in the divisor or in both the divisor and dividend, then the decimal point must be moved as many places as it takes to clear the decimal point from the divisor:

$.45\overline{)7.65}$ becomes $45.\overline{)765.}$ decimal point moved two places

Then, divide as with whole numbers.

$.054\overline{).1026}$ becomes $054.\overline{)102.6}$

$54\overline{)102.6}$

*Practice

Changing Decimals Numbers to Fractions

Since decimals are fractions with denominators that are multiples of ten, to change a decimal number to a fractional number, put the number over the proper multiple of ten, reducing if possible.

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.6 = 6/10 = 3/5

.59 = 59/100

3.11 = 3 11/100

.913 = 913/1000

* Note that there are always as many zeroes in these fractions as there are decimal places in the original number.

*Practice

Changing Fractions into Decimals Numbers

To change a fraction into a decimal number, divide the numerator by the denominator and carry the division out as many places as necessary before either dividing equally or rounding off. If rounding off, carry out the division one place further than needed.

$$3/4 = 4\overline{)3} = 4\overline{)3.00}\ (.75,\ -28,\ 20)$$

$$17/46 = 46\overline{)17.000}\ (.369,\ -138,\ 320,\ -276,\ 440) = .37$$

*Practice

Skill Building Sheet #2

Practical Applications

The class will work on the first two problems individually. The last three problems will be a group effort with members made up of 1st, 3rd, 4th, and 5th year apprentices. The answers to the problems will be discussed. The union trainer will then apply the use of decimals to several job-related functions.

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*Note: Joe Stastny provided a very effective example of decimals use during this class session which led to a lively, often eye-opening, discussion period. Mr. Stastny illustrated the use of decimals by having two class members show how sheet metal workers' pay checks are affected by the various deductions for union activities. He had one participant begin with the standard hourly rate for sheet metal workers; the other participant began with a much lower hourly rate, which the class later realized was the hourly rate less the deductions. The first participant subtracted the listed deductions and the second participant simultaneously added each deduction. When each ended up with the other's beginning figure, it was clear just how much money was being distributed and exactly where it was going. All participants were by then engaged in conversations concerning their upcoming contract vote on where a proposed pay raise would be designated. Following this exercise, Mr. Stastny had two teams work on a measurement problem concerning the use of decimals numbers in determining the surface area of a piece of sheet metal.

SHEET METAL WORKERS' INTERNATIONAL ASSOCIATION LOCAL UNION #33
3666 Carnegie Avenue, Cleveland, OH 44115-2714
(216) 391-1645 Fax: 391-4335

Counties of: Ashtabula, Cuyahoga, Geauga and Lake

CLEVELAND DISTRICT BUILDING TRADES

EFFECTIVE: MAY 1, 1993 - EXPIRES: APRIL 30, 1994

CONTRACTORS HOURLY COST	$29.04	
Industry Promotion Fund	-.16	hours worked
IFUS	-.05	hours worked
Local Apprentice Training	-.07	hours worked
*National Apprentice Training Fund	-.12*	hours worked
JOURNEYMANS RATE - TOTAL	$28.64	per hour
Local Pension Fund	-2.00	hours worked
*National Pension Fund	-1.04*	hours paid
*COLA	-.10*	hours paid
Health & Welfare	-2.80	hours worked
BASIC WAGE SCALE - TAXABLE	$22.70	per hour
Working Dues/Equality Fund	-1.11	hours paid
JATC/Hardship	-.11	hours paid
TOTAL TAKE HOME PAY	$21.48	per hour

FOREMANS RATE: $1.00 per hour over Journeymans rate
OVERTIME: Monday thru Saturday PAID AT 1 1/2 TIMES THE REGULAR HOURLY RATE
Sunday & Holidays PAID AT 2 TIMES THE REGULAR HOURLY RATE

BREAKDOWN OF CONTRIBUTIONS:

CONTRACTOR:	Journeyman Rate	Apprentice Rate
Industry Promotion Fund	$ .16 hours worked	$ .16 hours worked
IFUS	.05 hours worked	.05 hours worked
Local Apprentice Training	.07 hours worked	.07 hours worked
*National Training Fund	.12* hours worked	.12* hours worked
NON-TAXABLE:		
Local Pension	$2.00 hours worked	-0-
*National Pension	1.04* hours paid	$1.04* hours paid
*COLA	.10* hours paid	.10* hours paid
Health & Welfare	2.80 hours worked	2.80 hours worked
ASSESSMENT:		
Working Dues/Equality	$1.11 hours paid	-0-
JATC/Hardship	.11 hours paid	.11 hours paid
TOTAL CONTRIBUTIONS	$7.56	$4.45
*National Benefit Funds	-1.26*	-1.26*
Local #33 Benefit Funds	$6.30	$3.19

*Send NATIONAL PENSION AND NATIONAL TRAINING PAYMENTS WITH ORIGINAL COPY TO: Sheet Metal Workers' National Benefit Funds, P O BOX 79321 Baltimore, MD 21279-0321.

Send all other copies and the balance of the funds to: Sheet Metal Workers' Local Union #33 Cleveland District Benefit Funds, 3666 Carnegie Avenue, Cleveland, OH 44115-2714.

TO AVOID DELINQUENCY, SEND ALL PAYMENTS AND REMITTANCE FORMS BEFORE THE 15TH OF THE MONTH!!

ALL FRINGES ARE TO BE PAID AS NOTED

Skill Building #1 Name _____

A. Write these in decimal numbers.

1. Two tenths
2. three and seventy-eight hundredths
3. forty seven and twelve thousandths
4. point one hundred twenty-seven ten thousandths

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

B. Add

5.
$$\begin{array}{r} 7.25 \\ .43 \\ 8.91 \\ +\ .67 \\ \hline \end{array}$$

6.
$$\begin{array}{r} 8.125 \\ 14.693 \\ 7.024 \\ +\ 9.567 \\ \hline \end{array}$$

7. $3.2 + 14.51 + 9 + .10 =$

C. Subtract

8.
$$\begin{array}{r} 17.84 \\ -\ 8.59 \\ \hline \end{array}$$

9.
$$\begin{array}{r} 24.061 \\ -\ 15.735 \\ \hline \end{array}$$

10.
$$\begin{array}{r} 85.00 \\ -\ 36.42 \\ \hline \end{array}$$

Total correct _____

Skill Building #2 Name _____

A. Multiply

1. $9 \times .8 =$

2. $1.3 \times 98 =$

3. $92.07 \times 7.3 =$

4. $\begin{array}{r} 12 \\ \times\ .7 \\ \hline \end{array}$

B. Divide

5. $8\overline{)25.6}$

6. $.038\overline{)5.32}$

7. $2.7\overline{)30.25}$

8. $.0003\overline{)2}$

C. Change into decimals

9. 9/10

10. 5/6

D. Change into fractions

11. .6

12. .084

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

_____

Total Correct

DECIMALS FOR SHEET METAL WORKERS

Practical Applications

Name _____

1. What is the total weight of five castings weighing 17 lbs., 21 lbs., 20.6 lbs., and 23.4 lbs.?

2. What is the difference in diameters of two steel castings measuring 4.2435 " and 4.2463 "?

3. In this table the first column lists the US Standard Sheet Metal gauge number. The second column gives the equivalent thickness as a fraction in inches. Complete the third column, giving the thickness as a decimal number rounded to the nearest thousandth of an inch. (No calculators, please)

Gauge #	Fraction Thickness	Decimal Thickness (in thousandths)
7-0	1/2	0.500
6-0	15/32	
5-0	7/16	
4-0	13/32	0.406
3-0	3/8	
2-0	11/32	
0-0	5/16	
1	9/32	

4. The following table lists the thickness in inches of several sizes of sheet metal:

US Gauge	Thickness
35	0.0075
30	0.0120
25	0.0209
20	0.0359
15	0.0673
10	0.1345
5	0.2092

What is the difference in thickness between a 30 gauge and a 25 gauge sheet?

What is the difference between 7 sheets of 25 gauge and 4 sheets of 20 gauge?

What length of 3/16 " rivet is needed to join one thickness of 25 gauge sheet to a strip of 1/4 " stock? (Add 1 1/2 times the diameter of the rivet to the length of the rivet in order to assure that the rivet is long enough to form a proper rivet hea

5. In order to determine the average thickness of a metal sheet, a sheet metal worke measures it at five different locations. His measurements are 0.0401, 0.0417, 0.0462. 0.0407, and 0.0428. What is the average thickness of the sheet?

Practice/Review of operations with decimals

Solve.

1. $693. + .84 + 4.96 + 6.4$

2. $1.7 - .046$

3. $.127 \times 46$

4. $12\overline{).048}$

5. 2.436×10 _____

6. $.025 + 6.375$ _____

7. $319.747 + 5.5 + 12.0002 + 1.025$

8. $.627 \times 5.4$

9. $.019\overline{).095}$

10. $14.097 - 7.326$

11. $12 - 9.7$ _____

12. $1.064 \div 100$ _____

13. 9.112×21.1

14. $12\overline{)606.6}$

15. $30.604 - 1.365$

16. $\$698.75 + 645.36 + 426.74$

17. $.0178 \times 1000$ _____

18. $56.879 \div 1000$ _____

Round each decimal to the nearest thousandth.

19. 8.6483 _____

20. 2.0997 _____

21. 6.8935 _____

22. 4.0013 _____

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FRACTIONS

FOR

CARPENTARS

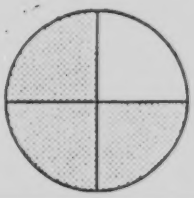
What Are Fractions?

A fraction is a part of something. A penny is a fraction of a dollar. It is one of the 100 equal parts of a dollar or $\frac{1}{100}$ (one hundred*th*) of a dollar. An inch is a fraction of a foot. It is one of the 12 equal parts of a foot or $\frac{1}{12}$ (one twelf*th*) of a foot. 5 days are a fraction of a week. They are 5 of the 7 equal parts of a week or $\frac{5}{7}$ (five seven*ths*) of a week.

The two numbers in a fraction are called the

numerator —which tells how many parts you have
denominator —which tells how many parts in the whole

EXAMPLE: The fraction $\frac{3}{4}$ tells you what part of the figure at the right is shaded. 3 parts are shaded. The whole figure is divided into 4 equal parts.



Forms of Fractions

Proper fraction —The top number is *less than* the bottom number.

EXAMPLES: $\frac{1}{3}, \frac{3}{10}, \frac{7}{19}$

A proper fraction is less than all the parts the whole is divided into. The value of a proper fraction is *always less than one.*

Improper fraction —The top number is *equal to or larger than* the bottom number.

EXAMPLES: $\frac{3}{2}, \frac{9}{4}, \frac{8}{8}$

An improper fraction is all the parts that a whole is divided into such as $\frac{8}{8}$, or it is more than the total parts in the whole. The value of an improper fraction is either *equal to one or more than one.*

Mixed number —A whole number is written next to a proper fraction.

EXAMPLES: $1\frac{2}{5}, 3\frac{1}{2}, 10\frac{4}{7}$

FRACTIONS

The form of a fraction may be changed without changing its value.

Reducing fractions to lowest form.

$\frac{4 \div 2}{6 \div 2} = \frac{2}{3}$ $\frac{9 \div 9}{27 \div 9} = \frac{1}{3}$ $\frac{36 \div 12}{48 \div 12} = \frac{3}{4}$

Try these:

$\frac{6}{10}$ $\frac{3}{9}$ $\frac{6}{64}$ $\frac{12}{32}$

Changing fractions to higher form or denominator

Change $\frac{4}{8} = \frac{\quad}{16}$, $\frac{4 \times 2}{8 \times 2} = \frac{8}{16}$

$\frac{3}{7} = \frac{\quad}{49}$ $\frac{3 \times 7}{7 \times 7} = \frac{27}{49}$

Try these:

$\frac{6}{8} = \frac{\quad}{64}$ $\frac{3}{16} = \frac{\quad}{32}$ $\frac{11}{56} = \frac{\quad}{168}$ $\frac{9}{13} = \frac{\quad}{104}$

Reducing an improper fraction to a whole or mixed number

$\frac{18}{3}$ $18 \div 3 = 6$ $\frac{36}{7}$ $36 \div 7 = 5\ 1/2$

FRACTIONS

Try these:

$\frac{44}{4}$ = $\frac{23}{5}$ = $\frac{240}{8}$ = $\frac{191}{6}$ =

Changing a mixed number to an improper fraction

4 1/2 = 9/2 8 3/4 = 35/4 4 5/8 = 37/8

Try these:

19 7/16 7 11/32 6 9/14 4 3/11

Adding like fractions and mixed numbers

$$\begin{array}{r} 4/8 \\ +\ 3/8 \\ \hline \end{array} \qquad \begin{array}{r} 5/12 \\ +\ 2/12 \\ \hline \end{array} \qquad \begin{array}{r} 4/9 \\ +\ 2/9 \\ \hline \end{array} \qquad \begin{array}{r} 8/13 \\ +\ 7/13 \\ \hline \end{array}$$

$$\begin{array}{r} 2/10 \\ 3/10 \\ +\ 3/10 \\ \hline \end{array} \qquad \begin{array}{r} 8\ 7/13 \\ +\ 6\ 4/13 \\ \hline \end{array} \qquad \begin{array}{r} 6\ 3/10 \\ +\ 8\ 6/10 \\ \hline \end{array} \qquad \begin{array}{r} 10\ 5/14 \\ +\ 8\ 7/14 \\ \hline \end{array}$$

Subtracting like fractions and mixed numbers

11/19	17/20	9/11	4/13
− 8/19	− 13/20	− 3/11	− 1/13
8 6/7	10 5/8	18 9/13	23 5/6
− 5 2/7	− 4 5/8	− 9 4/13	− 7 1/6

Adding and subtracting unlike fractions and mixed numbers

7/8	5/9	2/3	3/4
+ 3/4	+ 2/3	+ 5/6	1/2
			+ 3/20
3/4	1/2	5/9	5/6
− 3/16	− 3/10	− 1/6	− 3/5
21 8/9	13 4/7	12 3/4	4 5/12
− 6 1/4	− 7 3/8	8 5/6	4/9
		+ 2/3	+ 19 3/4

FRACTIONS

Borrowing and subtracting fractions

10	12	14 7/12	15 1/5
- 8/11	- 1/2	- 6 11/12	- 8 4/5
28 1/6	24 3/16	35 1/4	18 4/9
- 17 3/5	- 9 2/3	- 18 3/5	- 14 3/4

MIXED PRACTICE

5/16	5/6	5/8	7/10
+ 7/16	- 2/6	- 3/10	1/6
			+ 3/5
18 1/6	3 5/12	8 11/12	7
- 3	+ 2 7/12	- 3 3/12	- 7/9

FRACTIONS

1. A blueprint requires four separate pieces of wood measuring 5 3/8 in., 8 1/4 in. . 6 9/16 in., and 2 5/8 in. How long a piece of wood is needed to cut these pieces if we allow 1/2 in. for waste?

2. A cabinet 30" high must have a 4 1/2" base and a 1 3/4" top. How much space is left for drawers?

3. A counter top is made of 5/8 in. particle board and is covered with 3/16 in. laminated plastic. What width of metal edging is needed to finish off the edge?

4. An interior wall of a house is made up of 2 x 4 studs covered on each side with 3/4 in. wallboard. If the actual width of a 2 x 4 stud is 3 5/8 in., what is the total thickness of the wall?

5. A carpentar had a board 34 3/4 in. long. To fit the space for a shelf, he cut 7/16 in. off one end. How long was the board after the piece was removed?

6. Tom, the apprentice carpentar, measured the length of a 2 x 4 as 15 6/8 in. Express this measurement in lower terms.

7. The following lengths of lumber were cut from a board: 15 3/4, 48, 30 1/2, 23 7/8, and 12 5/8 in. If 1/8 in. of lumber was used in cutting each board, what was the total length used from the board?

8. A loaded truck was found to weigh 8,472 1/4 lbs. The truck when empty weighed 3,549 3/4 lbs. What was the weight of the load?

9. A sheet of plywood is made up of five sheets of wood. Two of the sheets are 3/16 in. thick and three of the sheets are 1/8 in. What is the total thickness of the sheet of plywood?

10. A carpentar used random widths of knotty pine to panel a room. Starting in one corner, he used pieces of pine 4 5/8, 7 5/8, 5 3/8, and 9 3/8 in. wide. How wide was the wall panel at that time?

FRACTIONS

Multiplying fraction by fraction

1. Multiply the numerators together.
2. Multiply the denominators together.
3. Reduce to lowest terms.

$\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$

Try these: $\frac{5}{9} \times \frac{3}{5}$ $\frac{3}{8} \times \frac{24}{36}$

$\frac{3}{12} \times \frac{1}{3} \times \frac{3}{5}$ $\frac{1}{8} \times \frac{16}{20} \times \frac{4}{5}$

Multiply fraction by whole number

1. Write the whole number as a fraction.
2. Follow the rules for multiplication.

$\frac{4}{5} \times 20 = \frac{16}{1} = 16$

Try these:

$\frac{5}{16} \times 32$ $\frac{3}{25} \times 100$ $14 \times \frac{5}{7}$

Multiplying mixed numbers

1. Write the mixed number as an improper fraction.
2. Follow the rules for multiplication.

5 1/2 x 3 1/2 = 11/2 x 10/3 = 55/3 = 18 1/3

Division of fractions, mixed numbers, and whole numbers

1. Invert the divisor
2. Follow the rules for multiplication.

FRACTIONS

Division continued

7/6 ÷ 2/3 = 7/6 x 3/2 = 21/12 = 1 9/12 = 1 3/4

Try these

10 ÷ 1 1/9 2 1/2 ÷ 2/7 5 3/5 ÷ 1 3/4

MIXED PRACTICE

Multiply or divide. Reduce the answers to lowest terms.

1. $\frac{5}{12} \times \frac{1}{5}$ ____
2. $\frac{14}{15} \times \frac{3}{7}$ ____
3. $\frac{7}{9} \times 36$ ____
4. $9\frac{3}{4} \times 1\frac{1}{3}$ ____
5. $5\frac{3}{7} \times 2\frac{5}{8}$ ____
6. $9 \times \frac{3}{8}$ ____
7. $\frac{1}{6} \div \frac{5}{9}$ ____
8. $\frac{15}{16} \div \frac{3}{8}$ ____
9. $\frac{1}{3} \div 9$ ____
10. $2\frac{3}{4} \div 2\frac{1}{7}$ ____
11. $6\frac{4}{5} \div 2\frac{2}{5}$ ____
12. $4 \div \frac{3}{4}$ ____

FRACTIONS

1. How many boards 4 5/8 in. wide will it take to cover a floor 18 1/2 ft. wide?

2. Find the total width of 36 two by fours if the finished width of each board is actually 3 1/2 in.

3. How many supporting columns 7 ft. 4 1/2 in. long can be cut from 6 pieces, each 22 ft. long?

4. What width of floor space can be covered by 48 boards each with 4 3/8 in. of exposed surface?

5. What length of 2" x 4" material will be required to make 6 bench legs each 2' 4 1/2" long?

6. How many pieces of 1/2 in. plywood are there in a stack 3 ft. 6 in. high?

7. There are 14 risers in the stairs from the basement to the first floor of a house. Find the distance if the risers are 7 1/8 inches high.

8. Find the width of floor space covered by 38 boards with 3 5/8 in. exposed surface each.

9. How many shelves, each 3 1/2 ft. long, can be cut from a board 14 ft. long? How much is left?

10. A carpentar worked on a job for 10 weeks, 5 1/2 days per week and 9 1/4 hours per day. How many hours did he work on the job?

PROBLEM SOLVING

CARPENTERS

APPLYING PROBLEM_SOLVING TECHNIQUES

Many situations in life present problems that need to be solved. A problem exists in any situation in which there is a difficulty or uncertainty that needs some creative or logical solution.

Problems that need solutions can arise in one's home life as well as on the job. For example how can a family with a limited income use their finances to provide adequately for food, shelter, and clothing and still have funds available for recreational purposes? How can an employee deal with a supervisor who is unknowingly creating friction between the members of his/her staff?

In order to deal with these problems that arise, a rational and organized approach is needed---one that can be applied in developing solutions to these problems.

One valuable technique that is commonly used to deal with a problem is called problem-solving. This technique requires the collection, application, and testing of information for the purpose of determining an appropriate solution to an existing problem. The problem-solving approach is a systematic procedure that involves the following basic steps:

1. Formulating and defining the problem clearly and concisely
2. Identifying the relevant factors
3. Gathering the needed information (facts and knowledge about the problem)
4. Examining possible solutions to the problem
5. Selecting a tentative solution or alternative solutions
6. Testing the proposed solution(s)
7. Assessing the results of the testing

Good problem solving involves following a sequence of rational steps, not simply waiting for a flash of understanding.

BASIC STEPS FOR PROBLEM SOLVING

1. Formulate and define the problem.

2. Identify the relevant factors.

3. Gather the needed information i.e. facts and knowledge about the problem.

4. Examine possible solutions.

5. Select tentative solution(s).

6. Test proposed solution(s).

7. Assess the results.

CASE

Mr. O'Leary, a recently employed carpentar, has the option of enrolling in a group medical-benefits program. The program has two plans from which to choose. Mr. O'Leary wants to enroll but is unsure about which plan would be most suitable for his situation.

First he analyzes the situation in terms of his estimated immediate and future medical needs and those of his wife and children. As a result of this analysis, he is able to compile a list of his family's possible medical needs.

Next, Mr. O'Leary makes a careful review of both plans to determine types of coverage, costs, length of coverage, and so on. As these facts are gathered and examined, he determines that Plan A would be most approprate to satisfy his family's predicted medical needs. Accordingly, he enrolls in Plan A.

During the course of the next year, Mr. O'Leary's eldest daughter loses both her front teeth as a result of falling out of a tree. Such dental care is not covered by Plan A, and Mr. O'Leary is forced to cover the entire cost of the rather large dental bill by himself.

At the end of the year, he reevaluates his decision to enroll in Plan A. He reviews the family's actual medical needs of the past year and how much of the resulting expenses were covered by Plan A. He determines that, except for the dental bill, Plan A suited the family well. However, since the family includes a number of active tree-climbing children, Mr. O'Leary decides to drop Plan A and enroll in Plan B, which has broader coverage (including dental emergencies) than Plan A.

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CASE

Problem Statement: Sean has been promised a job but cannot take it unless he can find transportation to get there. How can Sean get the transportation he needs?

Relevant factors: _____

_____

_____

_____

_____

_____

Information and facts about the problem: _____

_____

_____

_____

_____

_____

_____

Possible solutions: _____

_____

_____

_____

_____

Proposed solution: _____

_____

_____

ROLE PLAYING ACTIVITY

Assume that your peer is involved in the following problem situation. Guide the peer in identifying and defining the problem to be solved, determining the factors, gathering or identifying the information needed to solve the problem, examining possible solutions, selecting a tentative solution, and mentally evaluating the proposed solution. (Some relevant information may be missing. If so, you will need to help the peer determine what other facts are needed and how these facts can be located.

PROBLEM SITUATION

You have just received your diploma and have been offered two jobs: one in your small home town, and one in a large city 500 miles away.

The job in the city pays twice as much as the job in your home town, and the opportunities for advancement and raises are quite good. One reason the rewards are so great is that the pressures and responsibilities for self-motivation in completing work are heavy.

If you make good (you'll be competing against several other people, all of whom were picked for their skill and initiative), you'll probably be put in a supervisory position in a year or so, and how far you advance will depend on you. The personnel manager has told you that they are looking for someone who works well with other people; cooperation is necessary if the job is to get done right.

During your interview, you overheard several employees talking about putting in another long night to get some work out; one said he thought he'd have to come in on Saturday to meet the deadline.

The work surroundings look quite comfortable. Since there are no windows, the noise from the heavy city traffic and the smoke from the nearby factories won't be a problem.

The job in your home town has a much smaller salary, and raises (if any) will depend on how business is in a given year. However, the employer has been good friends with your family for years and has no family of his own. He would probably give you the option to buy the business in 10 or 15 years if you have the money and desire to do so. Therefore, your future has real possibilities if you decide to accept this job.

Nobody works past 6 p.m. at this job; working on weekends is practically unheard of. The employees are highly individualistic and value their privacy. Their lives away from the office are more important to them than their working lives, and their jobs depend more on seasonal fluctuations than on their ability to outperform someone else. Therefore, competition is minimal. The easy pace of the job reflects the lifestyle of the community; the sidewalks are rolled up at 9 p.m.

PROBLEM-SOLVING CHECKLIST

Directions: Place an X in the NO, PARTIAL, or FULL box to indicate that each of the following performance components was not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, a performance component was not applicable, or impossible to execute, place an X in the N/A box.

Name _____

Date _____

Resource Person _____

LEVEL OF PERFORMANCE

	N/A	No	Partial	Full
Under the instructor's guidance and direction, you were able to:				
1. clearly identify and define the problem	☐	☐	☐	☐
2. identify all major factors involved in the problem	☐	☐	☐	☐
3. locate sources from which to gather the needed information	☐	☐	☐	☐
4. gather the needed information	☐	☐	☐	☐
5. determine what additional information was needed	☐	☐	☐	☐
6. identify possible solutions	☐	☐	☐	☐
7. evaluate each possible solution	☐	☐	☐	☐
8. select a tentative solution	☐	☐	☐	☐
9. mentally evaluate the tentative solution	☐	☐	☐	☐
The instructor's directions were sufficiently clear that you would be able to:				
10. use these same problem-solving steps to solve future problems you might encounter	☐	☐	☐	☐